VOL. 26 No. 3

BULLETIN

OF THE

TORREY BOTANICAL CLUB

MARCH 1899

On the Development of the Pollen Grain and the Embryo-sac in Bignonia venusta

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(PLATES 352–354)

SPORANGIAL AND ARCHESPORIAL DEVELOPMENT

The microsporic Archesporium and Sporangium

Before the flower bud opens, median transverse and longitudinal sections of an anther of *Bignonia venusta* show the pollen mother-cells occupying four boat-shaped layers, as seen in cross section in Fig. 3. Each layer is a single cell in depth, and the general form of the archesporial areas somewhat closely resembles that characteristic of Solanaceae, Labiatae, etc., as described by Warming,* and as figured by him for *Datura Stramonium* and *Mentha aquatica.*

In *Bignonia* I have studied the archesporium and its investments in some detail, beginning with the archesporial and wall layer fundament. In Fig. 1, a cross-section of an anther from a bud of 1 to 2 mm. in diameter, it will be seen that the outer layer of periblem in two considerable regions on each side of a radial line is somewhat richer in protoplasmic contents, and it would seem to be already slightly differentiated as a fundament. General placental growth is now largely confined to the regions *x*, *x*. Placental growth, however, soon becomes more marked at *y*, *y*, and so continues until the general form is that of Fig. 2. Even

* Warming, E. Untersuchungen über Pollenbildende Phyllome und Kaulome. Bot. Abhandl. Hanstein, **2**: 1–90. 1873.

[Issued 18 March, 1899]

before the latter stage has resulted, the outer layer of periblem in general has become well differentiated, some of the hypodermal cells in the region *m*, *m* have already lost their previous slight differential character (or lose it entirely with further development), and the four regions of Fig. 2 are evident, but not sharply defined. Thus it would seem difficult here to locate the sporangia relative to the surface of the sporophyll on which borne, unless beginning with such a stage as Fig. 2, where the connective, *m*, is already distinctly different from the remaining portions of the hypodermal layer, and might be taken as separating an upper from a lower surface. Engler's * studies on many forms led to the conclusion that in both extrorse and introrse anthers two sporangia are borne on each surface. My observations on *Bignonia* suggested at an earlier stage a common fundament for each pair of sporangia in radial arrangement, and the improbability of any distinction between upper and lower surfaces in the young condition. Moreover, from what we know of stamens which have been partially changed from staminal to purely floral organs, as in *Canna* and in the pond lily, there is no such location of sporangia, it would seem.

The cells of the hypodermal layer at *x*, *x* and *y*, *y*, Fig. 1, divide by periclinal walls into two layers, as in Fig. 5. The inner of these layers rapidly becomes rich in protoplasm, the nucleus increases in size and the cell wall in thickness, and there results the primitive archesporium of about six or eight cells in each sporangial region, in cross section. In the primitive archesporium the cells undergo no further periclinal divisions, and a single layer is maintained until maturity; but at a later period, when the cells have increased in size and peculiarity, a few radial divisions occur, as in Figs. 6 and 10, usually increasing the extent of the layer to about thirteen cells at the middle part.

In the meantime the cells of the wall layer (secondary hypodermal) divide, forming on the inside a layer of cells soon differentiated as the outer tapetum, and on the outside the first true wall layer, Figs. 5 and 6. The next periclinal division throughout the wall layer, Fig. 7, completes the general development on the outer

* Engler, A., Beiträge zur Kenntniss der Antherenbildung der Metaspermen. Jahrb. wiss. Bot. 10: 275–316. 1876. Compare IV., "Uber die sogenannten introrsen und extrorsen Antheren, pp. 299–305."

side. However, around the ends of the boat-shaped archesporial masses, there is some irregularity. The cells equivalent to the general tapetum, as well as those of the outlying wall layer, usually divide several times, Fig. 8, so that the terminal portions of the archesporial layer are sunk deeper into the general tissue.

The layer of cells on the inner surface of the archesporium gradually differentiates itself into an inner tapetum, and here also there are no further tangential divisions.

The two general wall layers persist, and there is no fibrillar development of the outer wall layer. At the time of dehiscence of the anther, these layers are compressed, and the epidermis somewhat modified. According to the early work of Purkinge,* Mirbel† and others the endothecium of these writers (final wall layer) is always partially or wholly fibrous. The more extended study by Chatin ‡ upon developing, mature and dehiscing anthers in a large number of orders demonstrated that this generalization could not be made. Moreover, he found that the presence of fibrous structures is not at all dependent upon the natural position of the order. Chatin distinguished three general classes in which no fibrous layer occurred, as follows:

"1. Que les cellules fibreuses manquent, en général, dans les anthères á déhiscence poricide.

"2. Que les cellules fibreuses sont défaut dans un certain nombre d'anthères á déhiscense longitudinale.

"3. Que dans quelques plantes dont les étames paraissent avoir subi un arrêt de développement, sinon morphologique du moins histologique, l' absence de cellules fibreuses coincide avec la mauvaise conformation du pollen."

Thus he found that among dicotyledons the fibrous tissue is entirely absent in Melastomaceae, Vacciniaceae, and Ericaceae. Again, it is absent in members of such widely separated orders as Tremandraceae (*Tetratheca*), Caesalpinaceae (*Cassia*), Ebenaceae

* Purkinge, J. E. De cellulis antherarum fibrosis, Vratislaviae. 1830. [Ref. Chatin ‡.]

† Mirbel, Complément des observations sur le *Marchantia*, suivi de recherches sur la métamorphose des utricles et sur l'origine, les développements et la structure de l'anthère et du pollen dans les végétaux Phanérogames. Mém. de l'Acad. royale des Sci. 13: ——. 1835.

‡ Chatin, A. De l'Anthère, Paris. 1870.

(*Diospyros*), Myrsinaceae (*Badula*), Solanaceae (*Lycopersicum*), Acanthaceae (*Thunbergia*), Asclepiadaceae (*Gonolobus*), and Compositae (*Chaetophora*). It is evident that he noted the absence of such fibrous tissue in *Bignonia*, for he briefly refers to the large cells of the epidermis (see Fig. 11) as doubtless aiding in the dehiscence of the anther, these cells increasing in size very rapidly when the pollen approaches naturity.

During the growth of the archesporium, the tapetal cells may divide radially; but they soon become considerably modified in appearance, and only nuclear divisions occur. The process of nuclear activity in the tapetum are much as Strasburger* has described. The nuclei divide karyokinetically, Fig. 9, but no cell plate is formed. In time the daughter nuclei may move together, touch, and become flattened against each other, thus appearing as if in the process of direct division. In *Bignonia*, however, the nuclei often remain apart throughout.

It is of some interest to note the rate of growth in the cells of the archesporium, beginning even with the outer periblem layer which gives rise to the archesporium by its first periclinal divisions, measuring the time by the development of the archesporial investments, etc.

The following table indicates the measurements:

TIME.	ARCHESPORIAL.		
	Cell.	Nucleus.	Nucleolus.
Periblem layer first differentiated	9.5–13×11–13 μ	5.57 μ	2.8 μ
After the outer tapetum is cut off	11–15×16.5–19 μ	8–9.6 μ	4–4.8 μ
Immediately after the final division of the wall layer.	16.5–19×22–27.5 μ	11–14 μ	5.5 μ
During synapsis of the definitive archesporial cells..	30–44×44–60 μ	16.5–18×16.5–22 μ	6.9 μ

After synapsis there is little growth in the pollen mother-cells until divisions begin, although during the spirem stage the nucleolus often attains a general diameter of 8 μ, and a long diameter even greater.

Nucellus and Integument

The ovule development conforms quite closely to that characteristic of most Gamopetalae. The protuberance arising from the

* Strasburger, E. Theilungsvorgänge der Zellkerne, 99–100. 1882.

placental tissue is a small mass of parenchymatous cells, and in this mass of tissue, growth is much more rapid on one side than on the other, consequently giving the anatropous ovule. In the nucellar mass a large hypodermal cell is soon differentiated as the primitive archesporium. It is readily distinguished by its greater size and by the richness of its protoplasm, see Fig. 12. As this archesporial cell elongates apically, it is enveloped in the epidermal layer alone, and there is no further nucellar development. The funiculus is considerably enlarged, and the cells beneath the archesporial cells are considerably elongated, as in Fig. 13. The single thick integument develops from below these elongated basal cells. During the subsequent expansion of the archesporium into four cells, the nucellar cells are greatly compressed and stretched, as in Fig. 16. Finally, the growth of the embryo-sac causes the complete disorganization of these apical nucellar cells, which disintegrate as the embryo-sac pushes itself out to such an extent as to encroach upon the cells of the integument. Meanwhile, the cells at the base of the embryo-sac become thick-walled and further elongated.

Macrosporic Archesporium

In the microsporangia, both of the divisions of the pollen mother-cells are complete before there is any differentiation in the macrosporangium of the primitive archesporium, or initial cell. When first recognizable as the primitive archesporium, this hypodermal cell is about 15 μ in length. No tapetum is cut off, and growth is rapid. At the time of synapsis in the nucleus of this archesporial cell, the latter is 45 μ in length, and its size, when the spindle begins to form, is about 60 μ. The cell is rich in protoplasm, sometimes with a single vacuole in the vicinity of the nucleus. Owing to the narrow transverse diameter of the cell, the nucleus is often oblong in form. During the formation of the first spindle, the transverse diameter of the cell increases appreciably, Fig. 39. The two equivalent cells resulting from the first division rapidly divide again, usually synchronously in all details, Fig. 15, and there result the four highly differentiated and equivalent cells regarded as potential macrospores, as in Fig. 16. As a rule, the fourth cell of this axial row immediately begins to enlarge at the expense of the others, as shown in Fig. 17. I have noticed sev-

eral instances in which the third cell retained its normal appearance later than the first two; but ultimately the fourth cell develops the embryo-sac.

In having a single axial row of four cells, and in possessing no tapetum, *Bignonia* agrees with such monocotyledons as *Sisyrinchium iridifolium* and *Hemerocallis fulva* (usually), according to Strasburger *; and among gamopetalous dicotyledons, so far as I have found from literature accessible, with all that have been studied, namely, with Compositae * and Labiatae *; also with some Ranunculaceae † and Berberidaceae.‡

Embryo-sac

The embryo-sac develops by the immediate growth of the fourth or lowest macrospore in the axial row, as mentioned. Since reduction has already taken place, its nuclear divisions are of less interest. The embryo-sac is late in developing, and it is not mature when the flower is fully open. As a rule, it seems to become unhealthy in this conservatory material after the first or second division. The nuclei are small, and divide rapidly. Generally, the embryo-sac became disorganized so readily, and latest ages were so difficult to secure, that lack of effective pollination was suggested as a possible cause of the difficulty. Artificial pollination with pollen from the same plant was ineffective, and attempts were futile to secure in good condition pollen from other plants in distant greenhouses. Embryo-sacs with two and with four nuclei were more commonly seen, as in Fig. 18; but only in a single instance was a mature embryo-sac found, and this was perfectly normal, with the characteristic eight nuclei, as shown in Fig. 19. The three antipodals are free, with no indications of disintegration, the polar nuclei are beginning to fuse, and the sexual nucleus has taken up its position immediately below the two synergids.

* Strasburger, E. Angiospermem und Gymnospermen.

† *a*. Mann, L. E. The Embryo-sac of *Myosurus minimus*. Trans. and Proc. of Bot. Soc. Edinburgh, **29**: 351. 1892. *b*. Mottier, D. M. Contributions to the Embrology of the Ranunculaceae. Bot. Gaz. **20**: 241, 296. 1895.

‡ Andrews, F. M. Development of the Embryo-sac of *Jeffersonia diphylla*. Bot. Gaz. **20**: 423. 1895.

DEVELOPMENT OF THE POLLEN GRAIN AND OF THE DEFINITIVE ARCHESPORIUM.

Development of the Pollen Grain

Very early in the development of the microsporangium the definitive archesporium is differentiated, and the nuclei of the pollen mother-cells enter upon a considerable period of rest and growth. As previously mentioned, the few divisions which have occurred in the primitive archesporium are truly of the vegetative or homotypic character, and very little of interest is connected with them. The chromosomes are then small, oval or oblong, and number about fifty, the full number of the sporophyte generation.

The Resting archesporial Cell and its Nucleus

In general, from the time of the last divisions in the primitive archesporium until synapsis of the definitive cells, the pollen mother-cells increase in size to at least twice their former diameter, the nucleus is about two-thirds larger, and the nucleolus approximately one-half greater in diameter. The nucleolus, however, is now larger than the original nucleus of the early differentiated periblem layer.

In the resting cell the cytoplasm is closely netted and the nuclear membrane distinct. The nucleolus takes the gentian stain in the Flemming combination. It is a striking feature in these nuclei that there is very little chromatin on the reticulum, and the nucleolus takes the chromatin stain constantly. In the early period of growth the nucleolus shows a deeper-strained outer zone. This is more evident in the early stages, but before the time of synapsis it is no longer noticeable. Small clear spaces in the nucleolus, which have been termed vacuoles, are present. I have generally been able to trace to these spaces linin strands of the nucleolus, as in some other plants studied later ; and it seems highly probable that the appearance of small vacuolations are often only projections on the surface. This occurs not only during the reticulum stage, but also later.

The reticulum is more closely interlaced in the periphery of the nucleolus, and upon it are found slight thickenings and granules which give up their gentian readily. In addition, there are

found a few spherical chromatic masses at definite points on the linin, staining deeply with the gentian.

Under the lower powers the cytoplasm has a granular appearance, and under very high magnification it is very closely netted. In *Bignonia* the cytoplasm is very dense, and as a consequence kinoplasmic radiations or fibers are not so readily distinguished, and probably some effects, especially in later stages of division, are thus obscured.

Synapsis

On passing into the condition of synapsis, Fig. 20, the linin framework is somewhat thicker than in the resting condition. I have observed no double row of chromatic granules nor any indication of fission previous to the contraction of the thread. As usual, during synapsis the contracted linin mass stains poorly, taking the orange diffusely. The coils of the contracted mass are not entirely obscured by the density of the ball, but the diffuse staining renders problematical any full account of changes that may occur during this period.

The nucleolus is at one edge of the contracted thread, and from the optical periphery there are one or more projections on its surface. Several so-called vacuoles may be seen in the middle part, but these also often represent projections, sometimes swollen, leading to linin attachments. Sometimes these structures are refractive. In this stage the nucleolus of the tapetal cells shows some signs of disintegration, and upon its surface there appear very large and refractive clear spaces. These undoubtedly enclose air in some way, and by long treatment with xylol and alcohol, as suggested by Zimmermann,* or even with treatment by xylol alone, these vacuoles largely disappear. They disappear at least so far as the air present is concerned, but certain clear spaces remain as before, showing no special refractive power.

The Spirem Stage and Segmentation

No indication of a true spirem is seen until after synapsis, and the initiation of this spirem is marked by a stronger reaction to the stains. At first the spirem consists of a loose, slightly thickened

* Zimmermann, A. Morphologie und Physiologie des Zellkernes, 41.

thread with many small granules, and a few larger ones. At this stage I have found no indication of distinct rows of granules. They are evidently rapidly formed, however, for somewhat later there is a general splitting of the ribbon with its numerous granules (as in Fig. 21), the parts of which may be adjacent for some distance, and separating widely in other places. The divided thread becomes greatly looped and twisted, apparently making definite bends upon itself in certain regions, but there does not seem to be segmentation in the sense that the entire ribbon falls into distinct segments, the whole extent of each segment entering into a single chromosome (see Fig. 22). Nevertheless, each bent or loop-like portion resulting is undoubtedly the basis of a chromosome, and in a certain view the loop formation is very evident. The figures indicate that we may have a process closely parallel to what is described in the Hepaticae.* The resulting chromosomes often appear spherical, with a few projecting edges. They may seem to be made up of two or three chromatic masses closely fused; and again, or from another view, there is an evident concavity on one surface (Fig. 23).

Throughout this period, also, minute linin attachments connect the chromosomes and the nucleolus, and the nucleolus is often drawn out into a fusiform condition. Some abnormal nuclei occur in which the nucleolus is actually drawn out into the form of a ribbon.

In several anthers I have found two nuclei in many pollen mother-cells during the spirem stage. They are usually abnormal in form, but there has been no indication of how the division has been effected.

The First Division

On the disappearance of the nuclear membrane the kinoplasm of which it is composed opens into the nuclear hollow, the kinoplasmic threads of the membrane being apparently the first to be attached to the chromosomes. Soon, however, the kinoplasm enters from all directions, and it is drawn into the form of a truly multipolar spindle, as often described (see Fig. 24). The general

* Farmer, J. B. On Spore-Formation and Nuclear Division in the Hepaticae. Ann. Bot. **9**: 469–523. 1895.

axis of the spindle is finally determined; so that it becomes multipolar in one general plane, and then by a gradual contraction process it becomes bipolar.

The chromosomes seem to increase in size just before the disappearance of the nuclear membrane. On this entrance of the kinoplasmic fibers there is no indication of the nucleolus, and I have no evidence of the manner of its disappearance.

During the later stages of spindle formation the chromosomes seem to change their form, possibly the splitting having already begun. When they are finally brought into an equatorial region, the alignment is not perfect (Figs. 25, 26), and the chromosomes are much scattered. This is characteristic of all first divisions in the production of the reduced number of chromosomes. The dense cytoplasm is apparently repelled from the spindle region, and only the poles of the completed spindle reach into the denser zone (see Fig. 25), thus somewhat resembling the condition found in *Hemerocallis fulva*.* In *Bignonia*, however, the spindle fibers are very numerous, and they terminate in a more distinct apex. The spindle is very large for the total chromatin mass concerned. In this plant the nuclei are much larger than in others under study at the same time, but the chromosomes are much smaller.

Details of reduction phenomena were not followed, since the plants were not suitable for this purpose, but some especially interesting nucleolar phenomena were observed.

After the separation into the daughter segments the chromosomes show a very slight indication of a V-form, by short projections pointing towards the equator, as in Fig. 27. They pass to the poles in scattered and unaligned array, so that at this stage it is relatively an easy matter to estimate the number of chromosomes. From several counts I have concluded that there are twenty five, although twenty four and twenty six have been counted. In the very thin sections necessary for the study of these divisions the knife usually passes through some of the chromosomes, and from this results the only difficulty in counting them accurately.

* Juel, H. O. Die Kerntheilung in den Pollenmutterzellen von *Hemerocallis fulva* und die bei denselben auftretenden Unregelmässigkeiten. Jahrb. wiss. Bot. **30**: 205–226. 1897.

After the daughter nuclei are formed the dense cytoplasm rapidly fills the original nuclear hollow, and a very delicate spindle remains. In the dispirem of the daughter nuclei the chromosomes become very irregular in outline, and gradually diminish in size, while there is being gradually formed a large nucleolar-like body with irregular outlines (see Fig. 28). This body takes the chromatic dyes, as did the nucleolus generally before. Afterwards, it seems that this body resulting from the fusion of the chromatic masses is hardly fully differentiated as a nucleolus before the chromatin is again rapidly deposited upon the linin, and the chromosomes are again differentiated for the second division. Here there is evidence of an interesting connection between the chromatin content and the nucleolus.

The Second Division

With the disappearance of the nuclear membrane, the chromosomes prepared for the second division are short and irregularly oblong, broader from one side view than from the other, apparently, and along the middle line of the broader side there is indication of a fission. I have not observed all stages in the formation of the second spindle, but in general it seems to be the same as in the case of the first spindle, except that the second is much more rapidly formed. The second spindle is much narrower than the first, and it is composed of relatively few bundles of fibers, rather than of the loose network of the first division (see Fig. 26). The fibers are more in the form of compact bundles, however, than in the first division (see Fig. 29). In this division there is also a fairly distinct nuclear hollow remaining. Arranged on the nuclear plate, the chromosomes have their long diameter in the plane of the equator, and separation is along the line of fission previously indicated, so that the resulting daughter segments are small and oval in axial view, and somewhat bacilloidal in polar view. Contrary to the condition in the anaphase of the first spindle, these daughter chromosomes move to the poles in a definite line, as in Fig. 30. The remaining central spindle is also composed of a small number of delicate fibers, and the spindle space is rapidly occupied by dense cytoplasm. With the formation of the nuclear membrane, a few polar radiations are evident, and the whole cyto-

plasm shows the effect of a general radial arrangement, from which there is soon differentiated the complex spindle characteristic of dicotyledons (Fig. 31).

In the daughter nuclei it is again evident that the chromosomes first become irregular and slightly fused, as in Fig. 31, and gradually the fusion continues, or by some process it is returned to one or to several chromatic masses. Where there are several large masses first formed, the fusion of these into a single mass is not always evident; but eventually one prominent nucleolus results, as in Fig. 32, thus agreeing with the condition found in the first division. This gradual mergence of the chromatin mass into characteristic forms has been carefully followed, and various stages in the return of the chromatin from the chromosome state to that of the large nuclear masses are shown in Fig. 33. This mass is at first irregular in outline, but in time this irregularity is lost. One or more linin attachments persist, and everything indicates that the nucleolus of the microspore nucleus has thus resulted from the direct or indirect fusion of chromatic material used in division.

The Microspore

The forming microspores become invested with walls of their own, even the cell plates of previous divisions disintegrating with the general wall of the mother-cell. When first set free, the microspore is somewhat elliptical in form, the nucleus small, and the nucleolus relatively large. It remains in the resting condition for some time, and undergoes a period of growth, during which time the tapetal cells disintegrate rapidly. Until the divisions in the pollen mother-cells are begun the tapetal cells have undergone no disintegration, although becoming granular in appearance and staining deeply. The mature microspore is invested with a very thick wall, and owing to lack of stages and some difficulties with fixing, I have not been able to study the division of the microspore nucleus. As a result of this division, however, the pollen grain contains a larger vegetative nucleus, and a smaller more chromatic generative nucleus. The latter is not separated in a daughter-cell by a permanent cell wall, for in the mature pollen grain it is a free nucleus. Division of the generative nucleus does not take place previous to germination.

DIVISIONS IN THE FORMATIONS OF THE AXIAL ROW OF THE NUCELLUS

Bignonia has not proved a very favorable subject for the study of the axial row divisions in the ovule. Besides being very small, the ovules are not readily separated from the placental attachments, and it is almost necessary to section the entire ovary. Moreover, the developing ovules are bent, and it is difficult properly to orient them so as to have the archesporial axis in a desired plane. Innumerable sections have afforded me only some of the salient stages, sufficient, however, to demonstrate the general method of the reduction divisions. It was very manifest that the reduction divisions did not take place in the embryo-sac, owing to the absence of the characteristic prophase appearance in its nucleus. Moreover, since all of the gamopetalous dicotyledons yet worked upon have no tapetum and only an axial row of four cells developed from the archesporial cell,* in any of these plants where such uniformity seems to exist it seemed of interest to study the divisions in the formation of the axial row. Details of the general macrosporic development have already been given, and here only division phenomena will be briefly discussed.

The resting nucleus of the initial cell is at first much like that of the underlying growing cells of the nucellus. The nucleolus is then relatively small and readily loses the gentian stain for the orange. There is a loose reticulum of linin threads, and upon this a considerable number of large granules taking the chromatin stain.

As in the nuclei of the pollen mother-cells, synapsis is manifest at an early prophase stage. It is marked by the usual contraction of the linin ribbon, which is always in contact with the nucleolus on one side. The whole mass is usually in the center of the oval nucleus, the nucleolus in this case being in contact with the nuclear membrane, as in Fig. 34.

The archesporial cell has attained considerable length when the nucleus enters upon the spirem stage. The return from the condition of synapsis is especially marked by much better staining in the general ribbon. The ribbon is somewhat thicker than before,

* Strasburger, Angiospermen und Gymnospermen.

and the few large chromatic granules are replaced by a more chromatic ribbon, and by many more very evident granules, giving to the ribbon a nodulate appearance, as in Fig. 35. Moreover, the ribbon is coiled and looped in definite curves; and it may be readily seen that there are no anastomoses of the general thread.

The process of chromosome formation seems to follow the general method outlined for the first division of the pollen mother-cell, except that here no such definite loops or rings have been observed. Radiating from the nuclear membrane in the direction of the axis, especially, are kinoplasmic threads. The disappearance of the nuclear membrane initiates the formation of a loose spindle in every way equivalent to the one first formed in the pollen mother-cell. The chromosomes are again irregularly scattered in the region of the nuclear plate, and the characteristic heterotypic division of this plant is unmistakable (Fig. 38). In this case, however, there is no large space free from trophoplasm immediately surrounding the spindle. I have also been able to estimate the number of chromosomes in this division, and it corresponds to the reduced number of the male archesporium, about twenty five.

After the formation of the daughter nuclei, the chromosomes may be identified for a time (Fig. 39), but as no later telophase stages were found, I have no notes concerning the reappearance of the nucleolus, or the early stages in the formation of the second spindle. When the second spindle is complete (Fig. 40), a glistening cell wall separates the two daughter-cells, there is no indication of the former spindle fibers, and the cytoplasm is contracted or repelled from the newly-formed wall. The chromosomes are arranged at the nuclear plate in a definite plane, and the characteristic homotypic division is evident. They separate longitudinally, and the bacilloidal daughter segments pass to the poles on a definite alignment, as in the corresponding division in the microsporic development.

There is every reason to believe that these divisions are truly homologous with the two divisions in the pollen mother-cell, and that here we have the reducing divisions preceding the formation of the female sexual nucleus. Of the monocotyledons yet pub-

lished upon, species of *Allium** show reduction, or the indication of reduction, in the division of the initial cells ; and among dicotyledons *Helleborus foetidus* and *Podophyllum peltatum*† show the reduced number of chromosomes during the formation of the axial row.

Notes on Material and on Methods

Material of *Bignonia venusta* in quantity was secured from the botanical conservatories. A single cluster of flower buds will give many stages of development ; but when it is desired to have material showing division in the pollen mother-cells, it is quite necessary to examine an anther from each bud in order to avoid loss of time in sectioning useless material. At first I experienced some difficulty in securing such stages from collections made during bright forenoons. On examining a number of buds it was easy roughly to locate the beginning of division by the bursting of the calyx lobes. By this means, during the early afternoon I located and marked about twenty buds apparently just preceding division. Half a dozen buds of the same stage were then examined as checks, and found to be just preceding the formation of the spindle. At ten o'clock the following morning the marked buds were examined and all of them had passed through both divisions of the pollen mother-cells. This one experiment, together with previous failures, led me to suspect that these divisions were very rapid in this plant, and probably occurred at night. Material collected at night did yield many divisions, but at noon on a cloudy day I likewise secured all material desired of these stages. Nevertheless, it may be of interest that these divisions were never found during bright days.

Fixing, embedding, etc. In general, the material studied was fixed in Flemming's solution, as this proves so generally satisfactory in work with plant tissues. The mixture is substantially Flemming's strong solution, and the formulae are given in percentages, and as made up for ½ gram osmic acid :

* Strasburger, Ueber Kern und Zellteilung im Pflanzenreich, Histol. Beitr. H. I., 243.

† Mottier, D. M., Ueber das Verhalten der Kerne bei der Entwickelung des Embryosacks und die Vorgänge bei der Befruchtung. Jahrb. wiss. Bot. **31**: 125–158. 1897.

16 c.c.	1%	Chromic acid		1⅓ grams
3 c.c.	2%	Osmic acid	or	½ grams
1 c.c.		Glacial acetic acid		8⅓ c.c.
		Water, about		160 c.c.

The Flemming triple stain of safranin, gentian violet, and orange was used to some extent. After much experimentation, however, it was found advisable to leave out the safranin. Gentian of the full strength recommended gave good results in chromosome differentiation; but the spindle structures were not then well stained. For spindle structures, and for the differentiation of the kinoplasm, best results were obtained by the use of a very weak gentian, in which the sections were stained from twelve to twenty-four hours.

Explanation of Plates.

PLATE 352.

All figures were drawn with the aid of an Abbè camera lucida, projection 30 cm., tube length 15.5 cm., Leitz oculars 3 and 8, and objectives 7 and $\frac{1}{16}$ (hom. imm.) were used.

FIG. 1. Cross section of young anther showing early differentiation of periblem layer, from which the archesporium and wall layers are eventually derived.

FIG. 2. The four sporangial regions well differentiated; later than Fig. 1.

FIG. 3. Outline of mature anthers in cross section.

FIG. 4. Division of the hypodermal layer forming primitive archesporium within.

FIGS. 5 and 6. Formation of the first true wall layer without, and the outer tapetum within.

FIG. 7. Development of the two wall layers.

FIG. 8. Extra growth around the ends of the archesporial regions.

FIG. 9. Nuclear division in the tapetal cells.

FIG. 10. Increase in extent of the archesporial layer by anticlinal divisions of the vegetative type.

FIG. 11. Epidermis and wall layers at the maturity of the anthers.

FIG. 12. Differentiation of the hypodermal cell as the initial cell of the macrosporic archesporium.

FIG. 13. Growth of the archesporium and development of the integument.

FIG. 14. Archesporial cell immediately preceding the first division.

PLATE 353.

FIG. 15. Second division in the axial row.

FIG. 16. The four cells of the axial row.

FIG. 17. Development of the fourth cell in the axial row at the expense of the others.

FIG. 18. Developing embryo-sac with two small nuclei.

FIG. 19. Mature embryo-sac with synergids and egg-cell, fusing polar nuclei, and antipodals.

FIG. 20. Nucleus of the pollen mother-cell in synapsis.

FIG. 21. Longitudinal division of the spirem thread.

FIG. 22. An early stage in the differentiation of the chromosomes in the nucleus of the pollen mother-cell.

FIG. 23. Nucleus with mature chromosomes.

FIG. 24. Formation of the multipolar spindle.

FIG. 25. The complete spindle of the pollen mother-cell showing scattered chromosomes and nuclear hollow.

FIG. 26. An enlarged view of a spindle in the same stage as in the preceding figure.

FIG. 27. A characteristic spindle in the anaphase of division.

FIG. 28. A telophase of the first division in which the chromatic substance is largely fused into a nucleolar-like body.

PLATE 354.

FIG. 29. Compact second spindle of the pollen mother-cell.

FIG. 30. An anaphase stage of the second division.

FIG. 31. A telephase of division before the formation of a cell plate.

FIG. 32. An early stage in the differentiation of the microspores.

FIG. 33. Various appearances of the chromatin content in the dispirem of the second division, preceding the formation of a nucleolus.

FIG. 34. Synapsis in the nucleus of the axial-row mother-cell.

FIG. 35. A spirem stage in the nucleus of the axial-row mother-cell.

FIG. 36. A nucleus showing longitudinal division of the spirem thread.

FIG. 37. A nucleus with chromosomes well formed.

FIG. 38. The first division in the macrosporic archesporium.

FIG. 39. A telephase stage in the same division.

FIG. 40. Complete spindles of the second division in the macrosporic archesporium.

CORNELL UNIVERSITY, ITHACA, N. Y.

Studies in the Leguminosae.—III

By Anna Murray Vail

I. NOTES ON THE GENUS DOLICHOLUS (RHYNCHOSIA) IN THE UNITED STATES

DOLICHOLUS Medik. Vorles. Chur. Phys. **2**: 354. 1787. [Bot. Beob. des Jahres 1783: 211. 1784.]

[Rhynchosia Lour. Fl. Cochin. 460. 1790.]

[Arcyphyllum Ell. Journ. Acad. Phila. **1**: 371. 1818.]

[Copisma E. Meyer, Com. Pl. Afric. Austr. 132. 1835–1837.]*

Key to the Species

Copisma.—Twining, usually prostrate and trailing, or rarely more erect, perennial herbs: leaves 3-foliolate, the lateral leaflets inequilateral: flowers in slender axillary racemes or few-flowered clusters: calyx marcescent, not at all foliaceous, somewhat bilabiate, deeply 4-cleft; teeth subulate, the middle one the longest: corolla exceeding the calyx-teeth.—E. Meyer.

Racemes very slender, many-flowered, exceeding the leaves; flowers and legumes reflexed. 1. *D. minimus.*

Racemes 2–6-flowered, as long as or shorter than the leaves. 2. *D. parvifolius.*

Flowers short-pedicelled, solitary, or several together in the axils of the leaves. 3. *D. Texensis.*

Racemes short-peduncled, 2–4-flowered; bracts persistent. 4. *D. Swartzii.*

Arcyphyllum.—Slender, upright or elongated perennial, often twining herbs: leaves simple or 3-foliolate; lateral leaflets inequilateral: flowers in short-peduncled, axillary, few-flowered or, crowded clusters, or rarely elongated racemes: calyx 4-parted nearly to the base, persistent, the foliaceous segments linear or oblong-lanceolate, acuminate, nearly equal, the upper ones 2-toothed: corolla not exceeding the calyx-teeth.—Ell. Journ. Acad. Phila. **1**: 371. 1818.

Prostrate or climbing perennial vines.

Leaves unifoliolate or in *D. Michauxii* rarely the uppermost trifoliolate; racemes axillary.

Leaves reniform, cordate at base. 5. *D. Americanus.*

Leaves reniform, truncate at base. 6. *D. Michauxii.*

* The monotypic genus *Pitcheria*, Nutt. Journ. Acad. Phila. **7**: 93. 1834, though difficult to distinguish from *Dolicholus* by any absolute characters, differs from it greatly in general appearance and habit.

Leaves trifoliolate.
Racemes very short-peduncled or sessile.
Stems prostrate; leaflets cinereous. 7. *D. cinereus.*
Stems generally climbing.
Leaflets thickish, entire, ovate-rhombic. 8. *D. tomentosus.*
Leaflets thin, the margin with a few, broad rounded undulations. *D. tomentosus undulatus.*
Racemes peduncled or the uppermost short-peduncled, becoming elongated.
Prostrate; leaflets apiculate, 2.5–3.5 cm. long. 9. *D. Torreyi.*
Climbing vines.
Leaflets obovate-orbicular, thin, rounded at the broad apex, narrowed at the subcordate base. 10. *D. Lewtoni.*
Leaflets ovate or ovate-rhombic, thick, velvety-pubescent; racemes commonly much elongated. 11. *D. latifolius.*
Erect perennial herbs.
Leaves unifoliolate, reniform. 12. *D. simplicifolius.*
Leaves trifoliolate or some of the basal ones simple.
Racemes terminal and axillary, never long-peduncled and elongated.
Stems simple, 1–2 dm. high. 13. *D. intermedius.*
Stems simple or branched.
Racemes numerous, short, axillary; leaflets thick, velvety-pubescent, acutish or obtuse. 14. *D. erectus.*
Racemes numerous, short, axillary; leaflets densely velutinous, acute. 15. *D. Drummondii.*
Racemes terminal or a few of them axillary, commonly much elongated. 16. *D. mollissimus.*

1. **Dolicholus minimus** (L.) Medik. Vorles. Chur. Phys. **2**: 354. 1787.

Dolichos minimus L. Sp. Pl. 726. 1753.
Glycine reflexa Nutt. Gen. **2**: 115. 1818.
Rhynchosia Caribaea Nutt. Am. Journ. Sci. **5**: 298. 1822. Not *Glycine Caribaea* Jacq. 1786.
Glycine Lamarkii H.B.K. Nov. Gen. **6**: 424. 1823.
Glycine punctata DC. Mém. Leg. 365. 1823.
Glycine littoralis Vahl.; DC. Prodr. **2**: 385. 1825.
Rhynchosia minima DC. Prodr. **2**: 385. 1825.
Rhynchosia Caribaea DC. Prodr. **2**: 386. 1823.
Rhynchosia ervoidea DC. Prodr. **2**: 386. 1825.
Phaseolus Caribaeus Eat. & Wright. 353. 1840.
* *Rhynchosia Mexicana* Hook. & Arn. Bot. Beech. Voy. 287. 1841.

* The synonymy given here is only that which can be applied to the American plant.

In pine woods, South Carolina to Florida, Texas and southward to Brazil.

A common plant in tropical regions. Very variable. An exceedingly small-leaved and flowered form occurs on the Florida Keys.

Type in the Linnean Herbarium.

2. **Dolicholus parvifolius** (DC.)

Rhynchosia parvifolia DC. Mém. Leg. 367. 1823.

Florida; West Indies. Apparently not common.

3. **Dolicholus Texensis** (Torr. & Gr.)

Rhynchosia Texana Torr. & Gray, Fl. N. Am. **1**: 387. 1838.

In dry soil, Texas to Arizona and North Mexico. Also in South Brazil and Argentina.

Type in the Herbarium of Columbia University.

This species has been reduced to *Dolicholus Senna* (Gillies) Kuntze (*Rhynchosia Senna* Gill. H. & A. Bot. Misc. **3**: 199. 1844). I have kept them apart here as the latter species is not very well known and will probably need further study to determine its rightful position.* There are two or even three distinct forms, of which very luxuriant ones with elongated stems and lanceolate-oblong or even linear upper leaves are *Dolicholus Texensis* var. *angustifolius* (*Rhynchosia Texana* var. *angustifolia*† Engelm. Pl. Wright. **1**: 44. 1852).

In Contribution à la Flore du Paraguay, by M. Micheli (Mem. Soc. Phys. Geneva, **28**: 1883). *Rhynchosia Texana* is maintained as distinct from *R. Senna* and a new species is described as *R. diversifolia* which apparently is very closely related to the *Dolicholus Texensis* var. *angustifolius* of North America.

4. **Dolicholus Swartzii**

Rhynchosia Caribaea Chapm. 104, 1860. Not *Glycine Caribaea* Jacquin. 1786.

A slender, somewhat twining perennial or woody vine. Stems

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*I am much indebted to Mr. J. Henry Burkill for valuable notes on some South American material of this species in the Herbarium of Kew Gardens.

† *Dolicholus angustifolius* Kuntze, Rev. Gen. Pl. **3**: 60. 1898.

apparently branching at the base, slightly striate, pubescent, sparingly resinous-dotted: stipules 4 mm. long, linear-lanceolate, ciliate, reflexed, at length caducous: petioles 2–6 cm. long, slender, channelled, pubescent: leaves 3-foliolate; terminal petiolule 8–12 mm. long; terminal leaflets 4–5 or 6 cm. long, ovate, long-acuminate, 3–4 cm. wide, rather thin, soft pubescent on both surfaces, resinous-dotted beneath; lateral leaflets smaller, inequilaterally ovate, commonly though not always long-acuminate: racemes 1–2 cm. long or less, 2–3 (?)-flowered, the short peduncles very slender: pedicels filiform, 3–4 mm. long, puberulent: bracts very small, persisting: calyx 3 mm. long, resinous-dotted; teeth shorter than the tube: corolla yellow, much exceeding the calyx; vexillum obovate, 8 mm. long, minutely puberulent and dotted with elevated yellow resinous dots or glands on the outside: ovary resinous-dotted, pubescent or bearded along the apex: legume 2.5–3 cm. long, 5–7 mm. wide, falcate, acute at the apex, tapering to the petiole, dark brown and coriaceous, pubescent, resinous-dotted: mature seeds 5–6 mm. long, oblong-ovoid, bright red.

South Florida; Cuba.

My attention was first called to this species two years ago by a fragment in the Chapman Collection in the Herbarium of Columbia University, which purported to be *Rhynchosia Caribaea* DC. It was also labelled "South Florida, Blodgett." Somewhat later in looking over a large bundle of miscellaneous leguminous and mostly unnamed material in the Torrey Collection, I found a good original specimen of Mr. Blodgett's from Key West, with the following note: "Climbing high on trees. Flowers yellow, all seasons. Damp places." I concluded that it was an unnamed species, but owing to the uncertainty attached to the identity of *Rhynchosia Caribaea* (*Glycine Caribaea* Jacquin, Icon. Rar. *t. 146.* 1786), I was unwilling to undertake the responsibility of giving it a new name. Since then I have had the opportunity of examining the Jacquin plate, with which our Florida plant does not seem to have anything in common, except the shape of the legume.

Besides these two specimens, I have seen the following: Rugel, no. 137, from Key West, February, 1846, ex-Herb. Shuttleworth in the Herbarium of the British Museum, where there are also two fragments labelled "Hispaniola, Dr. Swartz." In the Kew Herbarium there is a specimen of it from Wright's collecting in Cuba, no. 2323, inscribed as *Rhynchosia Caribaea* ex-Griesb. Catal. Pl.

Cubens. and another of the same extraction is in the Herbarium of the Missouri Botanic Garden.

A duplicate of Rugel's no. 137, an excellent complete specimen, is also to be found in the Herbarium of the Museum at Paris. The Rugel specimen in the British Museum Collection bears notes to the effect that the plant climbs on shrubs and that it is rare.

I have named the species in honor of Dr. Swartz, the eminent author of the Flora Indiae Occidentalis.

As regards the true *Rhynchosia Caribaea* there is so much misunderstanding that it would be difficult to venture an opinion in regard to its identity. In the Index Kewensis *R. Caribaea Auct. Plur. ex Benth. Mart. Fl. Bras 15: part 1. 205* is referred to *R. minima*, some broader-leaved forms of which certainly do resemble the plate on which *R. Caribaea* was based. The next reference in the Index is to *R. Caribaea DC. Prodr. 2: 384. Am. Bor.; Ind. Occ.; Afr. Trop. et austr.* and in the same work such species as *R. acuminatum* Eckl. R. Zeyl., *R. gibba* E. Meyer, *R. inflata* and *R. malacophylla* Boj. (Mauritius), *R. intermedia* Kotschy & Peyr. and others are referred to *R. Caribaea*. I have not been able to study most of these species very critically, but as regards *R. gibba*, judging from the large collection of that plant in the Herbarium of the British Museum and elsewhere, it seems very doubtful that it belongs to the American species.

The description of *R. Caribaea* DC. agrees well with Jacquin's plate, but the distribution of the species reads "*in ins. Caribaeis, ad ripam flum. Orinoci, ex* Kunth, Nov. Gen. Am. 6. '*125*' (425) et in Florida occidentali." This latter locality for the plant should refer to *R. reflexa* Nutt., then given as synonym, a species which is now rightfully reduced to *R. minima* (L.) DC., so that it is probable that the true *R. Caribaea* does not occur within the limits of the United States. Quite an extensive search in London and Paris for an authentic specimen of this species met with but scant success. In the Herbarium of the Museum of Paris there is a specimen which probably belongs to *R. Caribaea*. It has the following inscription: "*Rhynchosia Caribaea* Willd. Jacq. Ic. *t. 146.*" Pinned on the sheet after the fashion of the older herbaria is a small label with this note: "Phaseolus Madrepotanis pubescens, siliquis brevibus hirsutis horti nostri sesei [?] Ray. vol. 3, appendix.

Herbier de Vaillant." The writing on the label is supposed to be that of either Sherard or of Ray, and interlined and blurred so that a few of the words could only be guessed at. The "Herbier de Vaillant" contains many West Indian plants, among others specimens from the Antillian collection figured by Plumier,* and this specimen might have had some such provenance. In the Herbarium of the British Museum a specimen of Triana's collection in New Grenada also fairly well agrees with the Jacquin plate, as do also the specimens collected by Dr. Palmer, no. 269, from the State of Jalisco, Mexico, with, perhaps, the exception of the somewhat smaller leaves; but the latter specimens certainly are not *R. phaseoloides*, under which name they seem to have been distributed. Another plant, exactly matching Palmer's, was collected by Fred. Muller, no. 1768, in Mexico, in 1853. (Herb. Columbia Univ.) It has the very hirsute legume which is so marked a characteristic of the figure of *R. Caribaea*.

In Hemsley, Biologia Centr. Am. 1: 310, the distribution of *R. Caribaea* is given as South Mexico, near Tantoyuca (Ervenberg, no. 35) and "common in the West Indies and the northern part of South America; also in Tropical and South Africa." I have not seen the Ervenberg specimen, nor have I seen any South African specimens of *R. gibba*, which satisfied me as being identical with the plant figured by Jacquin. It proves a most interesting species, and it is to be hoped that these very incomplete notes will call the attention of collectors to it and possibly bring about a better knowledge of it and of its geographical distribution.

5. **Dolicholus Americanus** (Miller)

Lathyrus Americana Miller, Gardn. Dict. no. 19. 1768.

Rhynchosia menispermoidea DC. Mém. Leg. 364. 1823.

Phaseolus menispermoidea Eat. & Wright, N. Am. Bot. 353. 1840.

Texas to South Mexico.

* Plumier's Herbarium of West Indian plants is preserved in the Herbarium of the Jardin des Plantes at Paris, where it is easily accessible to students. It consists of ten folio volumes, the specimens glued on the pages and numbered. They are in various stages of preservation and are especially valuable as being the originals of the figures in the Fasciculi Plantarum Americanum and of many Linnean types as well as the "Herb. Surian" of De Candolle's Prodromus.

Type in the Herbarium of the British Museum. For the record of the identification of this species see the article on Houston's Central American Leguminosae by James Britten and E. G. Baker in Journal of Botany for June, 1897.

6. **Dolicholus Michauxii**

Rhynchosia Michauxii Vail, Bull. Torr. Bot. Club, **22**: 458. 1895.

Rhynchosia menispermoidea Chapm. Fl. 105. 1860. Not DC.

Dry pine barrens, Florida.

Type in the Herbarium of Columbia University.

7. **Dolicholus cinereus** (Nash)

Rhynchosia cinerea Nash, Bull. Torr. Bot. Club, **22**: 149. 1895.

High pine lands, Lake County and Pelican Key, Florida.

Type in the Herbarium of Columbia University.

8. **Dolicholus tomentosus** (L.)

Glycine tomentosa L. Sp. Pl. 754. 1753.

Glycine tomentosa volubilis Michx. Fl. Bor. Am. **2**: 63. 1803.

Glycine tomentosa Pursh, Fl. Am. Sept. 486. 1814. Excluding var.

Arcyphyllum difformis Ell. Journ. Acad. Philad. **1**: 371. 1818.

Rhynchosia difformis DC. Prodr. **2**: 384. 1825. ?

Rhynchosia tomentosa H. & Pl. Comp. Bot. Mag. **1**: 23. 1835. Excluding the specimens.

Rhynchosia volubilis Wood, Bot. & Fl. 96. 1873. Not *R. volubilis* Loureiro, 1793.

The Linnean description of the species includes "*Ononis caule volubile*" Gronov. 81 and "*Anonis phaseoloides scandens, floribus flavis sessilibus*" Dill. Elth. 30 *t. 26. f. 29*, where the illustration is a good one of the plant as it is known on our eastern seaboard. The Clayton plants referred to are represented by two specimens in the Herbarium of the British Museum, one of *Glycine tomentosa*, the plant as figured by Dillenius, and one of the erect, oblong-leaved species described by Walter in 1788 as *Trifolium erectum*.

A specimen of the twining *Glycine tomentosa* is also in the Linnean Herbarium.

In dry soil, Virginia to Florida, Mississippi and probably also in Texas.

Dolicholus tomentosus undulatus n. var.

Perennial. Stems slender, twining, angled and striate, minutely and retrorsely hirsute: petioles 2–4 cm. long, angled, hirsute: stipules ovate, 3–4 mm. long, ciliate, persisting: leaves 3-foliolate; terminal petiolules 8 mm. to 5 cm. long; terminal leaflets oval or orbicular-oval, 2–4 cm. long, wide, obtuse or subacute, thinnish, minutely pubescent on both surfaces, with a few broad undulations on the margins; lateral leaflets inequilaterally ovate, 2–4 cm. long: racemes subsessile, 1–4- or 5-flowered: calyx 8–9 mm. long, pubescent, ciliate, resinous-dotted; lobes oblong, lanceolate, acuminate, foliaceous: corolla orange-yellow? nearly as long as the calyx or barely exceeding it when expanded; vexillum minutely puberulent near the apex and ciliate: legume 1.5–1.8 cm. long, oblong, obliquely acute, 5–7 mm. wide, minutely pubescent, resinous-dotted and hirsute with longer scattered hairs especially on the sutures, 2-seeded: seeds nearly 4 mm. long, semi-orbicular, shining, grayish with lighter and also dark brown markings.

Thickets and fields near Jacksonville, Florida, Chapman, 1846. (Herb. Mo. Bot. Gard.); N. Am. Pl. Curtiss, no. 660, July; Curtiss, no. 4256, July 6, 1893. (Distribution from the U. S, Nat. Herb.); Second Distr. Pl. Southern States, Curtiss, no. 4903. July 6–17, 1894.

9. **Dolicholus Torreyi**

Rhynchosia Torreyi Vail, Bull. Torr. Bot. Club, **22**: 459. 1895.

Rhynchosia latifolia β Torr. & Gray, Fl. N. Am. **1**: 285. 1838. Not *R. latifolia* Nutt.

Sand hills, Texas, Dr. Leavenworth. Apparently not since collected.

Type in the Herbarium of Columbia University.

10. **Dolicholus Lewtoni**

Rhynchosia reticulata? Chapm. Fl. Ed. 3, 115. 1897. Not DC.

Soft pubescent and minutely resinous-dotted throughout. Stem prostrate, 3–5 dm. long or more, 4-angled, spreading or obscurely retrorse hirsute-pubescent, apparently not twining at the summit: stipules obliquely lanceolate, 6–8 mm. long: petioles rather distant, 4–6 cm. long, angled: terminal leaflets dilated or obovate-

orbicular, 4–6 cm. long, 4–8 cm. wide, commonly broadest above the middle, broadly rounded and sometimes slightly retuse at the apex, narrowly subcordate at the base; lateral leaflets obliquely obovate-oblong; venation reticulated: upper racemes sessile, 2–4 cm. long, the other on peduncles 2–4 cm. long: bracts lanceolate, 3–4 mm. long, slender: calyx 9–10 mm. long; segments foliaceous, exceeding the glabrous yellow corolla. Legume not seen.

Dry sandy soil, Orange County, Florida, F. L. Lewton, July 7, 1894.

Allied to *D. Michauxii* Vail, from which it differs in the trifoliolate, abnormally large leaves, which are notably broadest above the middle and with narrow and less prominent subcordate bases. The calyx and corolla are also smaller than those of *D. Michauxii* and the racemes are longer.

Type in the Herbarium of Columbia University.

11. **Dolicholus latifolius** (Nutt.)

Rhynchosia latifolia Nutt.; Torr. & Gr. Fl. N. Am. **1**: 285. 1838.

Phaseolus latifolius Eat. & Wright, N. Am. Bot. 353. 1840.

In dry soil, Missouri to Texas and Louisiana.

Very variable. A low erect or sub-erect form with short or sub-sessile racemes has been collected in Texas by Lindheimer and in Missouri by B. F. Bush and may possibly be distinct.

12. **Dolicholus simplicifolius** (Walt.)

Trifolium simplicifolium Walt. Fl. Car. 184. 1788.

Glycine tomentosa var. *monophylla* Michx. Fl. Bor. Am. **2**: 63. 1803.

Glycine reniformis Pursh, Fl. Am. Sept. **2**: 486. 1814.

Glycine monophylla Nutt. Gen. **2**: 115. 1818.

Arcyphyllum simplicifolium Ell. Journ. Acad. Phila. **1**: 371. 1818.

Glycine simplicifolia Ell. Sk. **2**: 234. 1825. Not H. B. K.

Rhynchosia reniformis DC. Prodr. **2**: 384. 1825.

Rhynchosia tomentosa var. *monophylla* Torr. & Gray, **1**: 284. 1838.

Phaseolus reniformis Eat. & Wright, N. Am. Bot. 353. 1840.

Psoralea alnifolia Bert. Mem. Acad. Sci. Bolog. **2**: 274. 1849.

Rhynchosia simplicifolia Wood, Bot. & Fl. 96. 1873.

In dry soil, Virginia to Florida, west to Louisiana.

Type in the Herbarium of the British Museum.

13. **Dolicholus intermedius** (Torr. & Gr.)

Rhynchosia tomentosa β *intermedia* Torr. & Gray, Fl. N. Am. **1**: 285. 1838.

Psoralea alopecurina Bertol. Mem. Acad. Sci. Bolog. **2**: 275. *pl. 14. f. 2.* 1849.

Stems erect, simple or possibly with 1 or 2 branches, angled, soft pubescent-tomentose, especially on the angles, 1.2–3 dm. high; stipules obliquely lanceolate, 6–9 mm. long, striate, red-brown, persistent: petioles 2.5–5 cm. long, densely pubescent; basal leaves simple; blades nearly orbicular or rhombic-orbicular, obtuse or depressed; upper leaves or only the uppermost 3-foliolate; terminal leaflet 2.5–5 cm. long, oval to ovate-orbicular, obtuse, sparingly pubescent above, pubescent and rugosely veined beneath when old; lateral leaflets obliquely oval or oblong, 2–3 cm. long, mucronulate, some of them subcordate at base: racemes terminal and axillary, sessile or short-peduncled; bracts lanceolate-linear, 1 cm. long, red-brown, pubescent outside, glabrous within: calyx 8–9 mm. long; teeth slender, veined, pubescent, resinous-dotted: corolla yellow; vexillum glabrous, the teeth at the base much shorter than the claw: legume not seen.

Allied to *D. simplicifolius* from which it differs in the 3-foliolate upper leaves, and generally taller and larger habit.

Georgia to Florida and Alabama. May to June.

Type in the Herbarium of Columbia University.

14. **Dolicholus erectus** (Walt.)

Trifolium erectum Walt. Fl. Car. 184. 1788.

Glycine tomentosa var. *erecta* Michx. Fl. Bor. Am. **2**: 63. 1803.

Glycine erecta Nutt. Gen. **2**: 114. 1818. ?

Arcyphyllum erectum Ell. Journ. Acad. Phila. **1**: 372. 1818.

Rhynchosia erecta DC. Prodr. **2**: 384. 1825.

Glycine Caroliniana Spreng. Syst. **3**: 197. 1826.

In dry soil, Delaware to Florida, west to Tennessee and Louisiana. Very variable.

Type apparently lost.

An oblong-leaved, rather remarkable form of this species has

been collected by Hall in Louisiana, in Salisbury, Maryland [Herb. Canby], and in Mississippi byW. L. McGee.

15. **Dolicholus Drummondii**

Rhynchosia tomentosa Hook. & Arn. Comp. Bot. Mag. **1**: 23. 1835. Not Linn.

Perennial, erect, densely velutinous-tomentose, 1.5–3 dm. high. Stems angled, a little undulate above: stipules lanceolate, acuminate, becoming reflexed, caducous; petioles 3–5 cm. long, angled and velutinous: leaves 3-foliolate; terminal leaflets oblong-lanceolate or a few of them oblong, 3–6 cm. long, 2–3 cm. wide, acute, densely velutinous tomentose on both surfaces, silvery above, the whole lower surface dotted with numerous orange-colored glands beneath the tomentum and the prominent veins reticulated beneath; lateral leaflets narrower, inequilateral, acute; racemes subsessile or very short peduncled: bracts 2.5 mm. long, linear-setaceous, caducous: calyx 6 mm. long, foliaceous, tomentulose and ciliate, resinous-dotted, the upper lobe 2-toothed to considerably below the middle: corolla included in the calyx, apparently a deep orange-yellow color; vexillum round-ovate, the auricles at the base rounded, minutely glandular-puberulent on the outer surfaces: legumes not seen.

Louisiana: Covington, Drummond, 1832; North Carolina: New Bern, Croom and Loomis, 1834.

Very close to *D. erectum* from which it differs in the acute leaflets, dense tomentum and somewhat smaller flowers.

Type specimens in the Herbarium of Columbia University.

16. **Dolicholus mollissimus** (Ell.)

Glycine mollissima Ell. Bot. **2**: 235. 1824.

Rhynchosia tomentosa var. ? *mollissima* Torr. & Gray, Fl. N. Am. **1**: 285. 1838.

Rhynchosia mollissima S. Wats. Biblio. Ind. **1**: 256. 1878.

Rhynchosia tomentosa var. *erecta* Chapm. Fl. 105. 1884. In part.

Stems erect, commonly simple, 3–6 dm. high, angled above, not flexuous, clothed with a close fine soft pubescence: stipules 6 mm. long, red-brown, lanceolate, acuminate; leaves rather remote, 5–9 cm. long; petioles 2.5–5 cm. long; leaflets oval or oval-oblong, acutish, 2.4–4.5 cm. long, 2–3.5 cm. wide, minutely apiculate, obscurely emarginate, clothed with a short pubescence, es-

pecially on the reticulated, resinous-dotted under surface; terminal leaflet the largest, the others not conspicuously inequilateral; racemes terminal, elongated, 6 cm.–1.8 dm. long, with often few, short racemes in the axils of the upper leaves: flowers scattered along the whole length of the often crowded rhachis: calyx 6–8 mm. long, pubescent, resinous-dotted, 4-parted about two-thirds to the base; teeth lanceolate: corolla yellow; vexillum glabrous, the spurs of the claw obtuse: legume oblong, 2 cm. long, 6 mm. wide, attenuated below, somewhat rounded on the ventral suture, with a short, acute, slightly curved acumination: seed nearly orbicular, 2.5 mm. broad, flattened: seeds ovoid, 4 mm. long, brown, mottled.

In pine barrens, Florida.

II. NOTE ON PAROSELA

The following species has been identified with *Parosela Arizonica:*

Parosela Lumholtzii (Rob. & Fern.)

Dalea Lumholtzii Rob. & Fern. Proc. Am. Acad. **30:** 115. 1894.
Parosela Arizonica Vail, Bull. Torr. Bot. Club, **24:** 14. 1897.

Vicinity of Tucson, Arizona; Las Pinitos, Sonora, Mexico.

COLUMBIA UNIVERSITY, March, 1899.

Notes on some new and little known Plants of the Alabama Flora

By Charles Mohr

Several forms of plums without flowers and mature fruit, but seemingly distinct, have been for years a source of perplexity. Later discoveries of several species undescribed before, made in other parts of the Southern States, render now the identification of these doubtful forms from this State possible.

Prunus injucunda Small, Bull. Torr. Bot. Club, **25**: 149. 1898.

A low unsightly shrub scarcely exceeding four feet in height, with short straggling branches and branchlets, was found on the sandstone cliffs, at the summit of the Alpine Mountains, Talladega County (near the signal station), alt. 1800 feet, in September, 1892. This shrub was recognized by Dr. Small to be identical with his *Prunus injucunda* from the mountains of northern Georgia.

Prunus hortulana Bailey, Gard. & For. **5**: 90. 1892.

A small tree about 15 feet, rarely more, in height, branching low, forming small thickets on the shell banks or shell heaps along the shores of the inlets of the sea in Mobile County (Westfowl River, Bayou Coden). Confounded by the writer with *Prunus maritima* until a specimen was submitted to Professor C. S. Sargent, who, declaring that it had nothing in common with the Seashore Plum, somewhat doubtfully referred the tree from the Alabama shore to Bailey's species.

The fruits received a few years ago were about the size of a small Chickasaw Plum, greenish, of a reddish blush and with a slight bloom, thus agreeing with the description of the fruit of *Prunus hortulana*. The fruit ripens in September.

Prunus maritima in Chapman's Flora S. States, Ed. 3, *Alabama, Buckley*, most probably belongs here.

Prunus Alabamensis sp. nov.

Tree below medium size, scarcely over 25 or 30 feet high, about 6 inches in diameter with a rough bark: leaves thick, broadly ovate, rounded or slightly narrowed at the base, short acuminate, obtuse

or acutish at the apex, bluntly serrate with appressed glandular-tipped teeth, smooth and of a dull green color above, paler and finely pubescent on the lower surface with short simple or forked rusty hairs, which become longer and more dense along the midrib and principal veins, veinlets somewhat prominent: racemes elongated, 4 to 6 inches long, peduncled, strictly erect; the rachis and short pedicels like the calyx pubescent; petals small (judging from the withered petals clinging yet to the calyx in the specimens collected on Red Mountain, near Birmingham).

As observed on the few fruiting specimens collected on the Chehawhaw Mountain (Talladega Co.), altitude about 2400 feet, the racemes become more spreading, drupes reddish to black and of the size of the fruit of the black wild cherry.

Readily distinguished from the latter by the character of the leaves and of the inflorescence as described above.

Not infrequent on the rocky summits (siliceous rocks) of the higher ridges in the Coosa Basin, Talladega County, Alpine Mountains. Clay: Chehawhaw Mountain in fruit, August 7th. Jefferson: Red Mountain, ledges of siliceous red iron ore, just past flowering, May 10, 1898.

Physalis monticola sp. nov.

Perennial from a horizontal rootstock; 10–12 inches high. Stem slender, assurgent, like the branches, angled and roughish by reflexed hairs along the angles; branches erect, more or less flexuous, becoming more villous towards their extremity with flat jointed single hairs: leaves ovate to oblong ovate, tapering at both ends, oblique at the base and decurrent on the narrow winged petiole, repand or subentire: leaf blade 1½ to 2 inches long, ¾ to 1 inch wide, thin, sparsely strigose, more densely hairy along the midrib, and principal veins, roughish hairy below, ciliolate; petioles ½ to 1 inch long: peduncles slender, nodding: calyx densely hairy at the base and on the lanceolate lobes: corolla ¾ inch wide, pubescent, dingy yellow with a dark brown center; anthers pale yellow: fruiting calyx deeply sunk at the base, ovate oblong, closed by the acuminate lobes, about 1½ inches long and ¾ inch wide at the base, not prominently angled.

Resembles slightly smoother forms of *Physalis heterophylla*. De Kalb County on Lookout mountain near Mentone, borders of fields, woods and pastures. In flower May 30, 1892; fine fruiting specimens collected in the same locality September 10, 1898.

Flowering specimens in poor condition were submitted to Mr. Rydberg, who pronounced the plant to be most probably new, but which with the scanty material at the time at command he would not undertake to describe.

EUPATORIUM LEPTOPHYLLUM DC. Prod. **5**: 176. 1836

Confounded by our botanists with *Eupatorium capillifolium*, with which it grows abundantly in the low flats of the Coast plain in old fields, pasture grounds and openings of the forest.

Differs from the latter in the broader divisions of the linear, not filiform leaves, the stouter wide spreading branches and slightly larger flowering heads.

Apparently confined to the Coast plain; eastward to Georgia. (*Savannah. DC. loc. cit.*)

Solidago pallescens sp. nov.

Stem erect, 2½ to 3 feet high, more or less sparsely branched about the middle, striate puberulent: radical leaves oblong lanceolate, attenuated at the base, with a slender petiole: lower cauline leaves oblong-ovate, contracted into a petiole-like base or sessile, obtuse mucronulate, 2½ to 3 inches long and 1 to 1½ inches wide, smooth, ciliolate, with several irregular sharp teeth above the middle; upper cauline and rameal leaves ovate to ovate-lanceolate, all with a prominent midrib, faintly veined, of a pale glaucous hue; upper leaves reduced at the flowering branches to spatulate bractlets: racemes slender, erect, spreading: flowering heads single or few in a cluster, crowded, small, scarcely over ⅛ inch long; involucral bracts rigid, obtuse, slightly pubescent on the margin: akenes faintly ribbed, strigose hairy.

Metamorphic hills. Auburn, Lee county, 800 to 1,000 feet altitude. Baker and Earle, October, 1897.

A distinctly marked species resembling *S. brachyphylla*, from which it is readily distinguished by the obtuse mucronulate leaves, nearly all sessile and pale glaucescent, but smaller flowers and faintly ribbed akenes.

GNAPHALIUM SPATHULATUM Lam. Encycl. **2**: 758. 1786

This winter annual strikes the observer in the field as clearly distinct from *Gnaphalium purpureum*, with which it has been confounded. Specimens submitted to Professor E. L. Greene were de-

cared to be identical with the allied species from tropical America. *Gnaphalium spathulatum* differs at once from the former by the simple stem, erect from the base like the leaves, greenish throughout every stage of growth, both covered loosely with a floccose woolly tomentum; by the cauline leaves being all broadly spatulate like the radical leaves; and further, by the racemose inflorescence with the flowering heads in close clusters, on the lower part of the stem borne on axillary branchlets one inch and over in length, and sessile towards its extremity.

Common in the southern part of the State from the Coast to the Prairie region in cultivated and waste-places, waysides, etc., flowering from the early spring to the close of the season. Always found in the vicinity of dwellings, apparently a fully naturalized introduction from the neighboring tropics; frequent in Mexico and the West Indies; *Gnaphalium Americanum* Mill. Dict. ? (Grisebach, Flor. Br. W. Ind.) seems to be the same species.

MOBILE, February 18, 1899.

New Plants from Wyoming.—VI

By Aven Nelson

Ruppia curvicarpa

Stems light green, 6 dm. or more in length, capillary and fragile at maturity: leaves variable in length, 3 cm. or more long: peduncles long; pedicels several in a cluster, capillary, fragile, from 3–6 cm. long: drupes black at maturity, oblong, 2 mm. in length, gibbous at base, hence appearing obliquely placed on the pedicel, increasing slightly in diameter upward to the abruptly bent beak which is tipped with a sharp acumination.

Very abundant in the "alkali" lakes that occur at intervals on the Laramie Plains. It is no doubt most nearly related to *R. maritima* L. from which its very characteristic fruits and long fragile pedicels seem to separate it. It differs also in its seasonal development as it does not appear to reach maturity until late in September.

Type specimen in Herb. University of Wyoming from Laramie Alkali Lakes, October 24, 1896.

Salicornia rubra

Annual with a strong taproot, erect, pyramidal in form, closely and divaricately branched from base to summit, the opposite branches regularly at right angles to the preceding pair and gradually shorter upward, the lower branches themselves similarly branched, rather stout, about 3 mm. in diameter when green, joints about as long as broad: scales short, approaching triangular, much wider than long, subacute: fruiting spikes 2–4 cm. long, very numerous, assuming a ruby red at maturity: middle flower higher than the lateral ones, reaching to the summit of the joint: the calyx broadly ovate, about 1.5 mm. long: utricle obscurely pubescent, oval, 1 mm. long.

This well-marked species is, perhaps, nearest to *S. herbacea* L. under which name it has in fact been distributed by me under no. 1162. Its very compact and stouter habit and short joints at once separate it from that species. It thrives best along the low banks of the "alkali" lakes of the plains. The soil in these situations is not simply impregnated with sodium chloride, but often thickly en-

crusted with other salts, principally sodium sulphate. On these white stretches this is often the only plant and as it reddens under the September sun these patches present a singularly beautiful appearance.

Type specimen in Herb. University of Wyoming, no. 5284, Laramie, September 6, 1898.

Arabis exilis

Biennial, possibly more enduring, 3–5 dm. high (including the raceme): taproot vertical or rarely curved at the summit: stems single, rarely 2 or more, mostly strict but occasionally branched above, minutely stellate-pubescent, glabrate upward: radical leaves small, crowded on the crown, oblong, acute at both ends, 8–14 mm. long, petioles mostly shorter than the blade; cauline somewhat crowded, the lower petioled, the upper sessile but not auriculate-clasping, minutely and closely stellate-pubescent as are the radical leaves, broadly linear or lanceolate, acute, 1–4 cm. long: raceme naked, glabrate, fully half the length of the plant, erect or the summit slightly nodding: sepals broadly linear, green or slightly tinged with purple, scarious-margined, 3–4 mm. long, pubescent as are the pedicels: petals white or purplish, linear-spatulate, nearly twice the length of the calyx: pods 4–6 cm. long, about 2 mm. wide, pendant on abruptly deflexed pedicels, 5–8 mm. long: seeds in two rows, oval, about 1 mm. long.

Its nearest ally seems to be *A. pulchra* Jones. Rather frequent and abundant on sage-brush plains in the southern part of the state. It seeks the rich, loose loam among the brush where it develops early.

Type specimen in Herb. University of Wyoming, no. 4523, Evanston, June 4, 1898.

Arabis lignifera

Perennial from a branched, lignescent base surmounting a woody taproot, 2–4 dm. high: annual stems usually several, erect or decumbent at base, simple below, somewhat branched above, from minutely stellate-pubescent to glabrous: leaves finely stellate-pubescent, entire, mostly basal, the conspicuous ones crowded on one or more short barren branches from the lignescent base, oblanceolate, 3–5 cm. long, tapering into a slender petiole as long or longer; those on the woody caudex oblong-oblanceolate, 10–20 mm. long, on slender petioles 2–3 times as long as the blade; cauline leaves, all but the lowest, short-auriculate, acute, narrowly

oblong below, lanceolate above, 2–4 cm. long: raceme from simple to paniculately branched, nearly or quite naked, glabrous or slightly pubescent on the pedicels: sepals oblong, obtuse, veinless, scarious margined, about 4 mm. long: petals white to pinkish, spatulate, twice as long as the sepals: pods from widely divaricate to pendulous, 3–4 cm. long, nearly 2 mm. wide; valves 1-nerved: seeds almost as broad as the valves, very narrowly winged, orbicular, at maturity in one irregular row.

The woody perennial base allies it to *A. suffrutescens* Gray, but its leaf, floral and fruit characters are quite different. It may be considered somewhat doubtfully a member of the section *Turritis*. It occurs rather scatteringly in the draws among the Green River Cliffs where it seeks the protection of the sage-brush. Type specimen no. 4711, Green River, June 4, 1898.

Lesquerella prostrata

Perennial: pubescence stellate throughout, dense, appressed: taproot woody, vertical, crown simple or branched: stems several, 5–20 from each crown, usually slender and flexuous-spreading, 10–15 cm. long (including the raceme) sometimes shorter and ascending: leaves crowded on the crowns, rhomboidal, oval or oblong, 3–15 mm. long, on petioles 2–4 times as long: cauline leaves few, oblanceolate to linear: raceme in fruit half the length of the stem: pedicels ascending or somewhat recurved, 5–10 mm. long: flowers somewhat congested, medium size: sepals ovate, delicately veined, somewhat unequal, the alternate ones with a scarious inflexed margin, about 5 mm. long: petals obovate or broadly spatulate, a little less than twice the length of the sepals: pods broadly ovate, not compressed; septum elliptic, mostly perforate: the valves slightly gibbous at base: style hardly equaling the length of the pod: ovules few, seeds only 1 or 2 in each cell.

The affinities of this plant seem to be with *L. spathulata* Rydberg, though of this I have not seen a specimen. It was secured on stony, gravelly slopes of Unita Co.; not plentiful. Type specimen in Herb. University of Wyoming, no. 4564, Piedmont, June 7, 1898.

Lepidium ramosissimum

Biennial, 2–4 dm. high, obscurely pruinose-pubescent, profusely branched, the branches either divaricate and crowded the whole length of an excurrent stem or diffusely spreading from the base, the branches also divaricately ramose: taproot stout, mostly perpendicular, only moderately long, producing but few,

slender, divaricate branches: first year's leaves crowded on the crown, pinnately coarsely toothed, the teeth simple or incisely cusped, oblanceolate in outline, 2–4 cm. long on petioles about equaling the blade, falling away during the winter and early part of the second season: second year's leaves cauline, smaller, numerous, sessile, the lower oblanceolate, laterally incisely few-toothed, three-toothed at apex, the middle tooth triangular and much the largest: upper leaves mostly entire, from linear to oblong: petals white, very small, narrowly spatulate, scarcely more than than half the length of the 1 mm. long oblong sepals: racemes very numerous, excessively crowded, the whole plant a relatively compact subglobose or conical mass of capsules from the ground up: capsules nearly smooth, broadly ovate, 3 mm. long on pedicels of about equal length, sinus relatively wide and shallow: seeds brown, subelliptic, not evidently margined: cotyledons incumbent.

For some time it has seemed probable that the *Lepidium* so common on the Laramie plains was not to be included under any of the described species. The incumbent cotyledons separate it at once from *L. Virginicum* L.; its undoubted biennial duration, short petals and bushy-branched habit separate it from both *L. Virginicum* and *L. medium* Greene, the only two to which it is closely allied.

This species has been distributed by me under nos. 1424 and 3356.

Lepidium ramosum

Biennial: taproot vertical, its rootlets slender and widely spreading: closely and corymbosely branched from the base, 15–20 cm. high, minutely granular-pubescent: leaves of the first season clustered on the crown, oblanceolate, serrate, or more rarely pinnatifid, petioled, falling away early the second season: cauline oblanceolate, entire, or sparingly serrate, comparatively large (3–5 cm. long): racemes numerous, many-flowered, contracted near the summit: pedicels spreading after anthesis, about equaling the capsule: petals spatulate, about equaling the wider subacute sepals: stamens 2: capsule orbicular, 3 mm. in diameter, smooth, obscurely veined, narrowly winged around the summit, the sinus relatively deep and narrow: seeds broadly semi-ovate, straight edged on the side of the cotyledons, narrowly winged at summit and on the curved side: cotyledons incumbent.

A few specimens of this species were distributed as *L. medium* Greene under no. 3092, Point of Rocks, June 1, 1897, but it will be seen from the foregoing description that it is closer to *L. apet-*

alum Gray, except in the petals. Its bushy-branched habit and biennial duration easily distinguish it. It is common throughout the Red Desert region of Southern Wyoming where it was first observed in 1897. Closer examination in 1898 shows that it is exceedingly abundant and remarkably uniform in size and habit.

Type specimen in Herb. University of Wyoming, no. 4682, Granger, June 13, 1898.

Streptanthus Wyomingensis

Biennial or possibly of longer duration: stems single or more often several from the crown, each usually somewhat branched, 2–5 dm. high (including the raceme), glabrous or nearly so throughout: leaves numerous, the radical laciniate-toothed, obovate on short margined petioles, early deciduous the second season; cauline (all except the lowest) clasping-auriculate, the lobes comparatively large and rounded, somewhat glaucous, the lowest coarsely dentate or nearly entire, oblong, 4–7 cm. long, the upper entire, gradually smaller upward: flowers large, ebracteate, congested during anthesis: calyx subcylindric; sepals oblong, 5 mm. long, petaloid, midvein greenish, especially toward the tip: petals white, sometimes tinged with pink as are the sepals, 10–12 mm. long, claw narrow, the limb spreading, nearly oval: stamens distinct, anthers nearly equaling the filament: pods slightly flattened, very variable in length, sometimes nearly 10 cm. long, only 1–1.5 mm. in diameter, erect or spreading, usually somewhat curved, on short (8 mm. long), stout, divaricate pedicels: stigma nearly sessile, 2-lobed: cotyledons accumbent.

A very distinct species of the dry desert region of south-central Wyoming where it occurs mostly as scattering specimens. Three collections of it have been secured, viz., at Green River in 1897, no. 3034; near the same place in 1898, no 4722, and at Tipton, no. 4787. Plants are in their prime during the first weeks of June, which must be considered early in the season at this high altitude.

Thelepodium paniculatum

Perennial, glabrous and somewhat glaucous throughout: taproot woody, vertical, usually simple: rootlets few to numerous, spreading: stems single, rarely 2 or more from the crown, simple below, at length paniculately branched above: radical leaves oblong, acute, tapering gradually to both base and apex, very short petioled, 2–6 cm. long: cauline sagittate-clasping, auricles short,

subacute, from oblong below to narrowly lanceolate above, the lower comparatively large (4–6 cm. long), diminishing upward: raceme closely corymbose during anthesis: sepals oblong-spatulate, slightly hooded at the tip, tinged with purple, about 4 mm. long: petals white or purplish, fully twice the length of the sepals, claw narrow, the limb obovate with a rounded or nearly truncate summit: pod nearly erect, subterete, slightly narrowed into a short, stipe-like base, 20–30 mm. long: style short but evident: pedicels ascending, 8–12 mm. long.

During the past few years specimens have been accumulated that have been doubtfully called *T. sagittatum* Endl. but two recent collections make it quite evident that this *Thelepodium* of southern Wyoming is distinct.

It seems to prefer moist ground among the sage brush on low lands adjacent to streams. Type specimen, no. 4673, Fossil, Uinta Co., where it is common on Twin Creek bottoms, June 12, 1898.

Lupinus alpestris

Perennial from stout, deep set roots: caudex woody, branched, producing one or more stems from each crown: stems annual but the subligneous bases often persistent, only moderately stout, nearly erect, 4–6 dm. high, striate, very short pubescent, simple, or corymbosely branched: leaflets 5–9, mostly 7, from narrowly oblong to spatulate or oblanceolate, narrowed or cuneate at base, apex obtuse and usually cusped, very variable in length (2–7 cm.), minutely appressed-pubescent, sometimes nearly glabrous above, whole plant appearing nearly green and smooth to the unaided eye: lower petioles much longer than the leaflets, gradually shorter upward so that the uppermost do not equal the leaflets: racemes terminal on the main stem and branches, at length rather loosely verticillately flowered: calyx but slightly saccate at base, silky-villous as are the pedicels; pedicels shorter than the small to medium sized flowers: corolla blue or light blue, the keel purple-tipped, standard about 10 mm. long: pod silky-hirsute, 2–3 cm. long when mature, about 8 mm. broad, 5-ovuled, usually fewer seeded: seeds very flat, oval, 4 mm. long.

For the past three or four years this plant has been tentatively held as *L. Sitgreavesii* Wats. Opportunity, the present year, of examining authentic specimens has shown this plant to be quite distinct from that. *L. Sitgreavesii* is a coarser plant, hirsute-pubescent, flowers larger, leaflets and ovules usually more numerous; its

range is in the Southwest, scarcely within the Rocky Mountains. *L. alpestris* seems to belong to the middle Rockies and is almost alpine, for it occurs, so far as observation goes, near the limit of trees. Its habitat (in Wyoming) is the loose, moist soil of the spruce woods. It has been collected in the Wind River Mts. (896); in the Sierra Madre (4243), and in the Medicine Bow Mts. (5070). The latter, the type number, by Mr. Elias Nelson, Aug. 22, 1898.

Viola vallicola

Nearly glabrous or finely puberulent, low caulescent: caudex short, erect, simple or somewhat branched at the crown: roots fascicled, fleshy, few to several: the few stems and several leaves clustered on the crowns: stems slender, with 2–4 internodes, at first very short but in age sometimes 15 cm. long: leaves entire, from broadly to narrowly ovate or oblong, mostly obtuse, with rounded base or, in the broadest leaves, subcordate, 2–5 cm. long; petioles very variable in length, about equaling the blade or in some of the radical twice as long, the uppermost cauline shorter than the blade: lower peduncles much elongated but scarcely surpassing the uppermost leaves: sepals lanceolate, glabrous: petals yellow, more or less streaked with purple, glabrous, 10–14 mm. long: pods large, oval, with numerous large ovoid seeds.

Heretofore confounded with *V. praemorsa* Dougl. which belongs to a range much to the northwest of this. That species is a much smaller plant, is nearly stemless and with coarse distant teeth on the small leaves.

The herbarium of the Missouri Botanical Garden contains but one specimen of this species beside those deposited by me, viz., Carl F. Baker's from Cameron Pass, but that is not wholly typical. It occurs in open ground, on moist, rich soil on stream banks in mountain valleys.

Collected in several places in the state, the following nos. well representing it: 43, 4340, 4345 and 4525.

Pachylophus montanus (Nutt.)

Oenothera montana Nutt.; T. & G. Fl. N. A. 1: 500. 1840.

Root large, from 1 dm. in young plants to several dm. long in older ones, simple or somewhat branched, woody with a somewhat fleshy cortex, crowns 1 or more, strictly acaulescent: leaves from

few to numerous on the crowns, the blade oblong or oblanceolate, irregularly, coarsely, pinnately toothed, acute at apex, from sparsely hirsute to green and glabrous on the faces, canescently hirsute on the margins and midrib, 3–5 cm. long, on petioles of about equal length: flowers few, calyx-tube equaling or but little shorter than the leaves, hirsute-pubescent, calyx lobes pinkish, lanceolate, glabrous but for a pubescent line down the middle, 2–2.5 cm. long: petals white, changing to pink (always drying pink), broadly obcordate, 2–3 cm. long; stamens but slightly unequal, the filaments but little longer than the anthers: capsule sessile, oblong or narrowly ovate, obscurely tubercled on the obtuse angles, 15–20 mm. long: seeds in two rows, crowded, brown or nearly black, irregularly obovate.

That this is the suppressed *Oenothera montana* there can be little doubt. Its distinctness was evident to Nuttall and must be to every one who sees it in the field. Though I have distributed it as *O. caespitosa* Nutt. (nos. 58 and 1221), the two species need never be confused. It was the evident distinctness of the two that led to the unfortunate distribution of the true *O. caespitosa* (nos. 926 and 1274) also under the wrong name.

In looking through this species cover in the Herb. Mo. Bot. Garden, I found some unnamed specimens as follows: By Hayden, two near the mouth of Wind River, May 20, 1860; one, Wind River Valley, June 29, 1860; one, Jackson's Hole, June 12, 1860; by Dr. C. M. Hines, two from the Valley of the Yellowstone, Montana (?), 1860, all of which are, without doubt, good *Pachylophus montanus*.

This plant differs strikingly from *P. caespitosus* (Nutt.) Raimann in its smaller size, its thicker, smaller leaves, smaller flowers, shorter calyx-tube, as well as in its root characters and habitat. It has been known to me for a number of years and I have never secured it except on the naked red, gravelly-clay slopes of the foothills. Here the large white flowers are very conspicuous against the red background to the night-flying insects which undoubtfully pollinate it. The changing to pink follows upon their fertilization and takes them out of competition with their neighbors.

My collection, of this species, no. 1896, Laramie, June 3, 1896, may be cited as typical.

Sphaerostigma minor

A small annual, usually simple stemmed, sometimes 2 or more erect stems from the base, 3–10 cm. high, minutely puberulent or at length glabrous: leaves rather crowded below, from linear to oblong or broader, entire, subacute, 12–25 mm. long, mostly short petioled, the radical distinctly so: flowers yellowish, minute, axillary, mostly crowded near the end of the stems: calyx-tube very short, nearly cylindrical, slightly larger upward, about as long as the narrowly ovate, obtusish segments: petals oval with acutish ends, scarcely exceeding the sepals and equalled by the pistil and the longer stamens, about 1.5 mm. long: capsule contorted or nearly straight, spreading or erect, linear, slightly attenuated upward, subcylindric, striate at maturity, obscurely puberulent: seeds in one row, oblong, subacute at the ends, smooth, about 1 mm. long.

Probably most nearly related to *Sphaerostigma strigulosa* (T. & G.) in fruit and floral characters.

An inconspicuous and scattering plant on the loose, shale cliffs bordering the Green and Platte Rivers. Type specimen in Herb. University of Wyoming no. 3047, Green River, May 31, 1897.

Peucedanum megarrhiza

Acaulescent, glabrous throughout: root enormous, semi-woody, deep-set, 1 m. (more or less) in length, 1 dm. (more or less) in diameter; caudex multicipital, very broadly caespitose, branches of caudex very numerous and crowded, thickly clothed with old leaf-sheaths: leaves few to several from each crown, rather rigidly erect, long petioled, pinnate; leaflets few, 2–5 rather distant pairs, from simple and narrowly linear to pinnatifid, 2–4 cm. long, when pinnatifid the segments few, linear or narrowly oblong, cuspidate as are the leaflets: scapes moderately stout, 15–25 cm. high, scarcely exceeding the leaves: umbel 8–12-rayed, rays widely spreading, some of them at length reflexed, nearly equal (shorter in the occasionally aborted umbellets), about 15 mm. long; pedicels 1–2 mm. long; involucels of a few short-lanceolate bracts: calyx teeth very short: petals yellow: fruit elliptic-oblong, 6–8 mm. long, half as broad: seeds strongly flattened dorsally, plane on the commissural surface; lateral ribs winged, hardly half as wide as the body of the seed, the dorsal and intermediate filiform or almost none: oil tubes about 3 in the intervals, 6–10 on the commissural face.

Certainly closely allied to *P. Parryi* C. & R. but at once to be distinguished by its strongly tufted habit, the stoutish, erect scapes

and leaves and by the linear leaflets and leaf segments. It occurs on dry, naked, clay ridges and slopes and on gully sides where its long, stout root anchors it, in spite of the torrents that occasionally pour over it. Two collections of it, no. 4769, Point of Rocks, June 16, 1898, and no. 4873, Chalk Mt., July 13, 1898, the latter by Mr. Elias Nelson.

Dodecatheon salinum

Crown very short, subglobose, 5–8 mm. in diameter: roots very numerous, fascicled, rather slender but somewhat fleshy: leaves 5–10 on the crown, widely spreading or merely ascending, glabrous, rather thin, in the older leaves distinctly reticulated, entire, usually elliptic, sometimes obovate or oblanceolate, obtuse, 2–4 cm. long, on slender (rarely margined) petioles from one fourth to one half as long, including the petiole about one fourth as long as the single erect scape: scape slender, 10–20 cm. high, purplish above, glabrous as is also the inflorescence: bracts few, short, oblong or spatulate, mostly obtusish: flowers from few to several (3–12), erect in bud on very short pedicels, nodding in anthesis, the erect fruiting pedicels much elongated (2–4 cm. long): segments of the corolla lilac-purple, the undivided part yellowish-white with an indistinct purplish ring near the base: stamen ring yellowish-white, shorter than the anthers; anthers purple with whitish margins: style glabrous, surpassing the stamens; capsule elliptic, probably when wholly mature somewhat exceeding the calyx, splitting from the obtuse summit into two equal valves: seeds very numerous.

The nearest ally of this seems to be *D. pauciflorum* Greene from which its smaller size, different leaves, bracts, stamens and capsule readily distinguish it. Then, too, the habitat is different. *D. pauciflorum* is of wet or boggy, meadow-like bottom lands while this occurs on moist, strongly saline flats where other vegetation is scanty.

Type specimen in Herb. University of Wyoming, no 3012, May 29, 1897. Collected again in 1898 near the same place. Under the above number a few specimens were sent out as *D. Jeffreyi* Moore, to which it bears but little resemblance.

Cuscuta Plattensis

Stems yellowish-green, moderately slender, climbing the full length of the stems of the host: flowers in either loose or dense paniculate cymes, short pedicelled: calyx lobes obtuse, suborbicular, somewhat exceeding 1 mm. in length, the tube very short:

corolla marcescent at the base of the capsule, its lobes short-ovate, obtuse, about half the length of the broadly campanulate tube, at first erect, but ultimately reflexed; tube about 2 mm. long: scales shorter than the tube, broadest at the truncate fringed summit: styles distinct, but slightly unequal, scarcely more than 1 mm. in length and not more than ¼ the length of the mature capsule: capsule subglobose, 5 mm. in diameter when mature, indehiscent; ovules 4, usually only one maturing, seeds broadly reniform.

Though not very closely allied, this species falls into the same section with *C. tenuiflora* Engelm. It has been twice secured, both times on the upper Platte. The first time in 1896, Aug. 27, in the Cañon of the Platte, no. 2768, and the past season by Mr. Elias Nelson, Horseshoe Park, July 13, no. 5053. The host plants thus far observed are *Grindelia*, *Solidago* and *Helianthus*.

Gilia spicata deserta var. nov.

Habit of the species, but usually shorter-stemmed: stems one or more from a woody root with one or more swollen crowns, lanate: basal leaves crowded on the crowns, mostly simple, linear; the cauline pinnatifid, the divisions few (3–5), linear; leaves and divisions shorter than in the species: inflorescence crowded-spicate, in dwarf plants approaching capitate: calyx closely and minutely glandular.

To be distinguished from the species by the shorter, stouter, more woolly stems: the more crowded and glandular inflorescence; the rosulate, crowded, nearly simple basal leaves; the slender divisions of the more pinnatifid stem leaves and its habitat. The species is of the sandy foothills in the Rocky Mountains in general while this variety has been secured only on the naked, red-clay slopes of the Red Desert region. Three collections of this variety are at hand: Point of Rocks, June 15, 1898, no. 4746; Fort Steele, June 18, 1898, no. 4832; Freezeout Hills, July 10, 1898, no. 4843, the latter by Mr. Elias Nelson.

Phacelia biennis

Biennial: root small, somewhat fleshy, conical, nearly straight and vertical, 5–8 cm. long, rarely much exceeding 10 mm. in diameter at the crown: stems strict, a single main stem from the crown 3–4 dm. high, with occasionally one or two smaller, erect accessory ones, closely canescent and slightly hispid with spreading hairs:

leaves rather numerous on the crowns, few and distant on the stems, simple or more generally with a pair of divergent, lanceolate lobes on the petiole near the base of the blade, appressed-hirsute, with a finer pubescence intermingled; blade oblong, subacute, 5–10 cm. long, 1–3 cm. wide: petioles broad, the lower about equaling the blade, shorter upwards, the upper leaves nearly sessile: inflorescence at first crowded, the cyme becoming more open with age as its short circinate spikes unroll and lengthen: sepals oblong-linear, in anthesis shorter than the corolla, lengthening with age, in fruit about 8 mm. long: corolla light blue, about 5 mm. long, the lobes obtuse, entire or nearly so, half the length of the tube, appendages inconspicuous and thin, united at the base of the filament: the filaments exserted, distinctly hirsute; style divided about half its length, glabrous.

At once distinguished by its small, biennial root, its strict habit, its ample leaves and accessory leaflets and hirsute stamens. Its habitat too is quite different from the other species, as this occurs in the moist loam of mountain valleys. Type specimen in Herb. University of Wyoming, no. 1323, Pole Creek, June 27, 1895.

Castilleia fasciculata

Perennial: taproot short, more or less branched below: caudex very short, scarcely more than a woody enlarged crown on the taproot: stems from a few to several from the crown, simple or nearly so, moderately slender, somewhat spreading at the base, very strict and fascicled above, cinereous-pubescent as are also the leaves and inflorescence (pubescence somewhat unequal—from puberulent to subhispid), 2–3 dm. high: leaves very variable, 3–6 cm. long, from nearly linear-entire to much divided, the lobes short or the leaves divided much beyond the middle, usually 3-lobed, the lateral lobes linear, widely divergent and shorter than the middle: inflorescence early elongating into a close, rather slender spike, 8–18 cm. long, constituting half, or even more, of the length of the stem: bracts not conspicuously colored, light green or indistinctly reddish or yellowish, 14–18 mm. long, 3-cleft below the middle from a broad base, the middle lobes lanceolate, nearly as long as the corolla, the lateral lobes linear, divergent, shorter than the middle one: calyx equally cleft before and behind, the lobes short-bifid: corolla hardly exceeding calyx and bracts, galea short, not more than half as long as the tube, and twice as long as the lip: lip slightly ventricose but not callous, its three teeth short-oblong, obtuse, as long as the ventricose portion: stamens mostly included in the galea; style exserted.

Closely allied to *C. viscidula*, but lacking the viscidity and easily distinguished by the strict habit of the somewhat fascicled stems. Collected by Mr. Elias Nelson, at Indian Grove Mountains, on fertile soil, in a draw among the sage-brush, July 18, 1898, no. 4998.

Some new Species from Washington

By K. M. Wiegand

(Plate 355)

The several sets of Washington plants collected by Mr. J. B. Flett afford the following apparently undescribed species. Two of these are from the vicinity of Tacoma and are already represented in the larger herbaria under other names. Those from the Olympic Mountains I have never seen from elsewhere.

Allium crenulatum

Very low and dwarf (4–5 cm. high), from a small globose bulb, the latter not fibrillar: scape 2-edged (1.25 mm. wide), edges crenulately roughened: leaves 3–4 cm. long, narrow (1.5 mm. wide), recurved, edges crenulate: umbel few-flowered: bracts two, large, scarious, ovate-oblong, acute (8–10 mm. long): pedicels shorter than the flowers: perianth pink, segments (8 mm. long) lanceolate, acutish: stamens one-half the length of the perianth: anthers short-oblong: filaments naked: ovary six-crested at the summit but not horned: style 1 mm. long. [Plate 355.]

Loose gravel near the summit of the Olympic Mountains in the vicinity of the headwaters of the Quilcene River.

Related to *A. plenianthum* Wats. but is smaller, with roughened angles to the scape, and has fewer flowers; the leaves are also much narrower.

Lathyrus Torreyi tenellus var. nov.

Very slender and weak, more or less decumbent at the base (10–25 cm. high) from a very slender rootstock, short-hirsute with crisp white hairs intermixed with a few sessile glands: leaves (4–5 cm. long) oblong: leaflets 5–7 pairs, small, thin, elliptical, acute at each end, mucronately pointed, light green (12–16 mm. long), sparingly hairy on both surfaces; pulvinus strongly hirsute; stipules (8 mm. long) semi-ovate-lanceolate, acuminate and hastate, the lower lobe acute; rachis scarcely prolonged beyond the upper leaflet: flowers (15–17 mm. long) 1–3 (mostly 2) on a slender hirsute peduncle 1–6 cm. long; pedi-

cels scarcely any: calyx campanulate (6–7 mm. long), 5-toothed, the upper teeth deltoid ovate, acute, the three lower subulate and nearly twice as long, sparingly hairy: corolla showy.

Oregon and Washington. The type is Flett's no. 276, collected at Tacoma; other specimens studied are:

Oregon, Hall, no. 117.

Washington, Henderson, Cooper.

The type of this species is stouter, less hirsute and has larger (15–20 mm. long) more oval leaves which are not so acute at the ends. The flowers are also smaller, commonly solitary and nearly sessile. The calyx is more deeply cleft, and the teeth longer, especially the upper. It has a more southern range from Santa Cruz to Oregon.

Hydrophyllum congestum

Stem 20 30 cm. high, rather weak, pubescent with sparse crisp hairs, sparsely branched: the cauline leaves 2–3 in number (20 cm. or less in length), pinnately 5-foliate, on rather long petioles; leaflets ovate-oblong, acute, the upper much larger and broadly ovate, all cleft incised and sharply toothed (3–5 cm. long) green and strigose above, crisp-pubescent and paler beneath: flowers in dense and nearly sessile clusters; the peduncles very short (15-20 mm. long); pedicels slender (8 mm. long), finely and crisply pubescent with tawny hairs: calyx small (5 mm. long), cleft nearly to the base, sinuses rounded, naked; lobes linear, obtuse (rarely acutish), 1-nerved, margins and surfaces densely clothed with tawny hairs intermixed with shorter ones: corolla short (8 mm. long) glabrous, cleft two-thirds of the way to the base, lobes oblong, rounded or slightly retuse at the appex; folds extending two-thirds of the way up, rather narrow, cellular-striate and glandular-ciliate: stamens with slender filaments 12 mm. long; anthers oblong (2.35 × 1.25 mm.) cordate at the base, rounded and apiculate at the summit: style forked at the tip, 12 mm. long.

Collected near Tacoma in 1896.

This species resembled *H. Virginicum* but differs in the more numerous leaflets, in the brownish hirsute covering of the nearly sessile inflorescence, and the densely hirsute calyx lobes. It also resembles *H. occidentale* Gray and *H. albifrons* Heller from which it differs principally in the short peduncles and form of the leaflets. *H. tenuipes* Heller has very long peduncles, the calyx is merely ciliate, and the hairs are not distinctly tawny.

Senecio Flettii

Slender (20 cm. high), entirely glabrous, apparently slightly fleshy: leaves mostly radical (8–12 cm. × 2 cm.), narrowly oblong, pinnately incised and parted and somewhat lyrate; divisions decurrent, oblong or more commonly obovate-cuneate, incisely toothed above, terminal portion of the leaf not enlarged, petioles as long as the blade, slender; cauline leaves 3–4, much smaller, upper quite small and with distant linear (6–8 mm. long) divisions: heads several in a capitate corymb, small (7 mm. high), on slender glabrous bracted pedicels: involucre narrowly campanulate; bracts 10–12, linear-lanceolate, thin, mostly acute, 1–2-nerved and green, whiter on the margins but scarcely scarious, calyculate outer bracts usually wanting: ray flowers only 2 or 4, longer than the disk, bright orange: achenes obovate, truncate, glabrous; pappus copious, white: tube of the corolla slender; limb elliptic (8 mm. long), the rounded apex 3–4-toothed: style slender: stigmas scarcely truncate: disk flowers numerous, orange: achenes and pappus same as in the ray flowers: corolla slender, evenly funnel-form, narrow, glabrous; lobes 5, acute: stamen-tube rather short, apex of the stamens obtuse, cubical tissue of the filament not enlarged: stigmas truncate. [Plate 355.]

Loose stones and gravel near the headwaters of the Quilcene river, Olympic Mountains.

This species belongs to the group represented by *S. Bolanderi* Gray, *S. lactiflorus* Greene, and *S. indecorus* Greene, but differs from the known species in its peculiarly lobed leaves, naked stem, and small glabrous heads. The early root leaves in some cases show a tendency to become orbicular and merely crenate.

Some Northwestern Erysiphaceae

By David Griffiths

The following list is prepared from material which has been accumulating since 1892. It is based upon specimens from South Dakota, Wyoming and Montana. The species recorded from the two latter States are in the nature of incidental gatherings which were made while engaged in other work during the summers of 1897 and 1898 in company with either Mr. L. W. Carter or Mr. T. A. Williams. Access has been had to the private herbarium and collections of Mr. Williams, and several hosts and one species are quoted from these collections. The list is by no means even approximately complete for the region covered. It is published simply as a preliminary list to which additions will doubtless be made when other localities are visited.

As might be expected from a knowledge of the altitudinal and climatic variations of the states mentioned, the species are exceedingly variable in both macroscopic and microscopic characters. These variations have been quite thoroughly worked out by Professor T. J. Burrill in Ellis & Everhart, N. A. Pyrenomycetes, but the variations here are in many cases still greater than recorded by either him or Dr. Rehm in Rabenhorst's Kryptogamen Flora. I find my material variable, especially in the extent of mycelial development and the usual microscopic measurements. In the matter of appendages, character of the wall of the perithecium and number of spores and asci I find less variation from published descriptions.

As to the identity of the species recorded here, there are two points regarding which there is some doubt. *Erysiphe cichoracearum* growing on *Bigelovia*, *Lygodesmia* and *Grindelia* appears to me to have some constant characters of its own. This I find to be the case in various exsiccatae which I have examined as well as in my own collections. The characteristics which appear to be the most distinctive are the abundant development of mycelium which gives a different appearance from the forms on the other

composites even to the naked eye ; and the number of asci and the lighter colored appendages are also quite characteristic. *Microsphaera diffusa* and *M. Ravenelii* are quite difficult of separation, especially in the immature condition. After careful examination of well authenticated specimens named by the describers, or duplicate specimens of the type material, I have referred my specimens on *Lathyrus* to *M. Ravenelii* and the forms on *Vicia* to *M. diffusa.* Attention might be called in passing to the necessity of good descriptions of the conidial stage of the Erysiphaceae as well as of the perithecial one. Some of my material shows good characters in the early condition of development.

An interesting observation regarding the apparent sudden appearance of *E. communis* on several species of *Polygonum* is worth recording. As stated before, the collection of fungi was begun in South Dakota in 1892, but no specimens of *E. communis* were found on *Polygonum* until 1895, when I found a few immature specimens in the northern part of the state, and Mr. Williams reported it from Brookings the same year. The next year more of it was found, and in 1897 and 1898 it was abundant everywhere. The fungus without doubt occurred on species of *Polygonum* long before we happened to find it ; but that it occurred in small quantity previous to 1896 there can be no doubt.

It is interesting to compare the vertical distribution of these species. This is governed mainly, no doubt, by the habits of the hosts ; but as some of the host plants recorded here are found at a much higher altitude and others at a much lower, the question naturally arises as to the extent of altitudinal influence. The following upper limits will be instructive :

ERYSIPHE COMMUNIS on *Oenothera albicaulis*, 6500 ft.

ERYSIPHE CICHORACEARUM on *Mertensia Sibirica*, 8500 ft.

ERYSIPHE GRAMINIS on *Agropyron tenerum*, 8500 ft.

MICROSPHAERA VACCINII on *Vaccinium Myrtillus microphyllum*, 8500 ft.

SPHAEROTHECA CASTAGNEI on *Arnica cordifolia*, 9500 ft.

SPHAEROTHECA HUMULI on *Viola Canadensis*, 7500 ft.

The altitudes are all given for localities on Clear Creek in the Big Horn Mountains in the vicinity of Buffalo, Wyo., where quite a complete collection was made from the base of the mountains to

the snow line, which here is located at about 10500 ft. *Sphaerotheca Castagnei* was found at the highest level on *Arnica cordifolia*. This host is very abundant here at lower altitudes, but this was the only locality in which it was found affected with this fungus.

Some attention has been paid to the distribution of the fungi on closely related hosts of the region. A study of the list will furnish the best general idea on this point. *E. cichoraceārum* has been found, as usual, on a great number of hosts and in several instances widely separated ones. While its favorite habitat appears to be on the composites it is by no means confined to this group. When these facts are taken into consideration it is rather astonishing to find an entire absence of the fungus on hosts which are generically related. A striking illustration came under my observation at Sheridan, Wyo. In the corner of a garden three species of the genus *Artemisia*—*A. Ludoviciana*, *A. tridentata* and *A. longifolia* were growing in profusion. They were in such close proximity that their branches were actually intertwined. Being in partially cultivated ground the growth of each was much more luxuriant than usual. *A. Ludoviciana* was loaded with *E. cichoraceārum*, but careful search failed to reveal any on the other two species. I am not aware that the fungus has ever been recorded on either of these two species. This is all the more astonishing when we consider the frequency with which *A. Ludoviciana* is affected. In the absence of direct experimental evidence no positive reason can be given for the absence of this fungus on the two species in question under such apparently favorable conditions. Although closely related there is, however, a great difference in the aromatic principle and the development of trichomes in the two species, which may account for the phenomenon at least in part. A parallel case was observed in two other species of the same genus at Buffalo, Wyo. *A. dracunculoides* and *A. Canadensis* were growing together. The former had an abundance of *E. cichoraceārum* upon it while the latter was entirely free. A directly opposite effect even in widely separated hosts was observed at Missoula, Mont. Here *Crataegus* and *Alnus* were growing so that the branches overlapped. The former was badly affected with *Phyllactinia suffulta* and the latter with *Microsphaera alni*. A small quantity of *P. suffulta* was found on the *Alnus* also.

ERYSIPHE CICHORACEARUM DC.

On *Verbena stricta* Vent., Oakwood, S. D.
Artemisia Ludoviciana Nutt., Missoula, Mont.; Aberdeen, S. D.; Sheridan, Wyo.; Ft. McKinney, Wyo.
Artemisia dracunculoides Pursh, Pierre, S. D.; Billings, Mont.; Buffalo, Wyo.
Achillea millefolium L., Sylvan Lake, S. D.
Boltonia asteroides L'Her., Aberdeen, S. D.
Rudbeckia hirta L., Sylvan Lake, S. D.
Ambrosia trifida L., Pierre, S. D.
Ambrosia psilostachya DC., Huron, S. D.; Billings, Mont.
Bigelovia graveolens albicaulis Gray, Merino, Wyo.; Ft. McKinney, Wyo.
Solidago nana Nutt., Inyan Kara Mt., Wyo.
Solidago Canadensis L., Tacoma Park, S. D.
Helianthus rigidus Desf., Aberdeen, S. D.
Helianthus annuus L., Missoula, Mont.
Helianthus tuberosus L., Redfield, S. D.
Helianthus giganteus L., Big Horn, Wyo.
Helianthus Maximilianus Schard., Aberdeen, S. D.
Hydrophyllum Virginicum L., Big Stone Lake, S. D.
Aster laevis L., Missoula, Mont.
Chrysopsis villosa Nutt., Buffalo, Wyo.
Helenium montanum Nutt., Missoula, Mont.
Mertensia Sibirica Don., Buffalo, Wyo.
Phacelia circinata Jacq., Missoula, Mont.
Galium triflorum Michx., Missoula, Mont.
Carduus altissimus L., Ft. McKinney, Wyo.
Grindelia squarrosa Donal, "L. A. K." Ranch, S. D.; Aberdeen, S. D.; Ft. McKinney, Wyo.
Balsamorrhiza sagittata Nutt., Buffalo, Wyo.
Macrocalyx nyctalea (L.) Kuntze, Big Stone Lake, S. D.
Lygodesmia juncea Don., Buffalo, Wyo.
Erigeron macranthus Nutt., Bear Lodge Mts., Wyo.

ERYSIPHE COMMUNIS (Wallr.) Fr.

On *Polygonum ramosissimum prolificum* Small, Rapid City, S. D.
Polygonum ramosissimum Michx., Rapid City, S. D.; Pierre, S. D.; Billings, Mont.

Polygonum littorale Link., Grindstone Buttes, S. D.
Polygonum aviculare L., Buffalo, Wyo.; Rapid City, S. D.
Lupinus sericeus Pursh, Inyan Kara Mt., Wyo.
Thalictrum purpurascens L., Tacoma Park, S. D.
Spiesia Lamberti (Pursh) Kuntze, Grindstone Buttes, S. D.; Buffalo, Wyo.
Ranunculus Pennsylvanica L., Little Mo. Buttes, Wyo.
Homalobus cespitosus Nutt., Inyan Kara Mt., Wyo.
Lotus Purshiana (Nutt.) Bisch., Belle Foursche, S. D.
Oenothera albicaulis Nutt., Buffalo, Wyo.
Trifolium varigatum Nutt., Lo Lo, Mont.
Psoralea tenuiflora Pursh, Billings, Mont.
Astragulus oroboides Americanus Gray, Buffalo, Wyo.
Astragulus frigidus Americanus (Hook.) Watson, Buffalo, Wyo.
Astragalus Canadensis L., Tacoma Park, S. D.
Lespedeza striata Hook. & Arn., Brookings, S. D.

ERYSIPHE GALEOPSIDIS DC.

On *Stachys palustris* L., Missoula, Mont.; Aberdeen, S. D.; Ft. McKinney, Wyo.; Huron, S. D.

ERYSIPHE GRAMINIS DC.

Poa nemoralis L., Bear Lodge Mts., Wyo.; Hot Springs, S. D. Lake Hendricks, S. D.
Poa serotina Ehr., Missoula, Mont.
Poa pratensis L., Ft. McKinney, Wyo.; Brookings, S. D.
Bromus unioloides Willd., Brookings, S. D.
Bromus breviaristatus (Hook.) Buckl., Buffalo, Wyo.; Missoula, Mont.
Agropyron tenerum Vasey, Buffalo, Wyo.
Beckmannia crucaeformis Hort., Belle Foursche, S. D.

SPHAEROTHECA CASTAGNEI Lev.

On *Lepargyraea argentea* (Nutt.) Greene, Sheridan, Wyo.; Devil's Tower, Wyo.
Lepargyraea Canadensis (L.) Greene, S. Fork Piney River, Wyo.
Troximon officinalis Weber, Billings, Mont.
Crepis runcinata T. & G., Buffalo, Wyo.
Arnica cordifolia Hook., Buffalo, Wyo.

Gillardia aristata Pursh, Missoula, Mont.
Troximon glaucum Pursh, Buffalo, Wyo.; Red Lodge, Mont.
Pedicularis Groenlandica Retz., Buffalo, Wyo.
Fragaria glauca (Watson) Rydb., Missoula, Mont.
Collomia linearis Nutt., S. Fork Piney River, Wyo.
Senecio triangularis Hook., Red Lodge, Mont.
Lophanthus anisatus Benth., Little, Mo.; Buttes, Wyo.
Bidens frondosa L., Scatterwood, S. D.

SPHAEROTHECA HUMULI (DC.) Burrill

On *Viola Canadensis* L., Buffalo, Wyo.
Geranium Richardsoni Fisch., Bear Lodge Mts., Wyo.
Humulus Lupulus L., Buffalo, Wyo.

SPHAEROTHECA EPILOBII (Link.) DeB.

On *Epilobium adenocaulon* Hausskn., Sylvan Lake, S. D.; Buffalo, Wyo.

SPHAEROTHECA MORS-UVAE (Schw.) B. & C.

On *Ribes lacustre* Prior., Buffalo, Wyo.
Ribes Hudsonianum Richards, Missoula, Mont.
Ribes floridum L'Her., Rondell, S. D.

SPHAEROTHECA PANNOSA (Wallr.) Fr.

On *Rosa Woodsii* Lindl., Ft. McKinney, Wyo.

PODOSPHAERA OXYACANTHAE (DC.) DeB.

On *Spiraea lucida* Dougl., S. Fork Piney River, Wyo.
Prunus Americana Marshall, Redfield, S. D.
Prunus Virginiana L., Bigstone Lake, S. D.
Prunus demissa Walp., S. Fork Piney River, Wyo.
Prunus pumila L., Brookings, S. D.
Crataegus rivularis Nutt., Little, Mo.; Buttes, Wyo.

PHYLLACTINIA SUFFULTA (Reb.) Sacc.

On *Philadelphus Lewisii* Pursh, Missoula, Mont.
Betula occidentalis Hook., Ft. McKinney, Wyo.
Crataegus rivularis Nutt., Missoula, Mont.
Cornus stolonifera Michx., Missoula, Mont.; Big Stone Lake, S. D.

Alnus incana virescens Watson, Missoula, Mont.
Negundo aceroides Moench., Brookings, S. D.
Fraxinus viridis Michx., Brookings, S. D.
Celastrus scandens L., Brookings, S. D.

MICROSPHAERA SYMPHORICARPI E. C. Howe

On *Symphoricarpos occidentalis* Hook., Tacoma Park, S. D.
Symphoricarpos racemosus Michx., Missoula, Mont.

MICROSPHAERA VACCINII C. & P.

On *Vaccinium Myrtillus microphyllum* Hook., Buffalo, Wyo.

MICROSPHAERA ALNI (DC.) Wint.

On *Syringa vulgaris* L., Brookings, S. D.
Euonymus atropurpureus Jacq., Brookings, S. D.
Alnus incana virescens Watson, Missoula, Mont.
Lonicera glaucescens Rydb., Bear Lodge Mts., Wyo.

MICROSPHAERA QUERCINA (Schw.) Burrill

On *Quercus macrocarpa* Michx., Little, Mo.; Buttes, Wyo.

MICROSPHAERA DIFFUSA C. & P.

On *Vicia Americana truncata* (Nutt.) Brewer, Snoma, S. D.
Vicia linearis (Nutt.) Greene, Brookings, S. D.
Vicia Americana Muhl., Buffalo, Wyo.
Glycyrrhiza lepidota Pursh, Little Mo. Buttes, Wyo.

MICROSPHAERA RAVENELII Berk.

On *Lathyrus vinosus* Muhl., Sylvan Lake, S. D; Bear Lodge Mts., Wyo.

UNCINULA SALICIS (DC.) Wint.

On *Salix cordata* Muhl., Aberdeen, S. D.
Salix sp., Little Mo. Buttes, Wyo.
Populus tremuloides Michx., Sylvan Lake, S. D.; Red Lodge, Mont.
Populus balsamifera L., Buffalo, Wyo.

UNCINULA MACROSPORA Peck.

On *Ulmus Americana* L., Brookings, S. D.

UNCINULA NECATOR (Schw.) Burrill.

On *Parthenocissus quinquefolia* (L.) Planch, Brookings, S. D.

COLUMBIA UNIVERSITY, March 1, 1899.

An Enumeration of the Plants collected by Dr. H H. Rusby in South America, 1885–1886.—XXVI

By H. H. Rusby

(Continued from Bull. Torr. Bot. Club, **25**: 545. 15 O. 1898.)

5–7 cm. long, branched, the branches elongated, very slender, spreading: leaves sessile by a broad base, those of the pair contiguous, 4–10 cm. long, .5–1.5 cm. broad, lance-linear, tapering from near the base and attenuate, strongly nerved, the principal nerves 5–7: cymes terminal, rather dense, 3–5 cm. broad, closely subtended by leaves similar to the others, though smaller: pedicils 5–10 mm. long, stoutish, strongly angled; calyx-tube hemispherical-campanulate, 3 mm. long, 4 mm. broad, the lobes 4 or 5 mm. long, attenuate from a broad base, the sinuses broad and rounded: corolla (apparently yellow), nearly 1 cm. long and broad, the lobes 7 mm. long, obovate, the apex rounded, minutely toothed: stamens inserted about 2 mm. from the base, 6 mm. long, the filaments broad, the anthers black, 1 mm. long and nearly as broad, attached by a very broad connective; stigmas broad, oval, exserted about 1 or 2 mm.

Ingenio del Oro, 10000 ft., Mar., 1886 (nos. 672 and 673).

Tetragonanthus gracilis (Griseb.) Kuntze, Rev. Gen. Pl. 431. Sorata and Unduavi, 10000 ft. (nos. 669 and 670). Grows on wet hillsides, in clearings.

Limnanthemum Humboldtianum (H.B.K.) Griseb. Gen. et Sp. Gent. 347. (*Villarsia Humboldtiana* H.B.K. Nov. Gen. et Sp. **3**: 187.) Reis, 1500 ft., June, 1886 (551). Grows in shallow pools.

HYDROPHYLLACEAE.

Phacelia Peruviana (R. & P.) Spreng. Syst. **1**: 584. Sorata, 8000 ft., Apr., 1885 (1157).

BORAGINACEAE.

Cordia discolor C. & S. Linnaea **4**: 482. 1829. Yungas, 6000 ft., 1885 (2051).

Cordia excelsa (Mart.) A. DC. Prod. **9**: 473. (*Gerasa-*

canthus excelsa Mart. in Flora **21**[2]: Beibl. 86. 1838). Reis, 1500 ft., June, 1886 (1903).

Cordia Gerasacanthus L. Syst. 936. [10th ed.] Beni River, July, 1886 (1902).

Cordia Guayaquilensis A. DC. Prod. **9**: 496. Yungas, 4000 ft., 1885 (2344).

Cordia hispidissima A. DC. Prod. **9**: 475. Mapiri, 2500 ft., May, 1886 (no. 1901). The same as Blanchet's no. 995.

Cordia laxiflora H.B.K. Nov. Gen. et Sp. **3**: 72 (?) Junction of Rivers Beni and Madre de Dios, Aug., 1886 (no. 2054) and Falls of Madeira, Brazil, Oct. (no. 2053). The same as Spruce's no. 1695 and Bang's no. 1394 and 1443, but not Glaziou's no. 11296. If not *C. laxiflora*, it is an undescribed species.

Cordia multispicata Cham. Linnaea **4**: 490. 1829. Var. *fide* Britton. To me it appears rather *C. ferruginea* R. & S. Syst. **4**: 458. Guanai, 2000 ft., May, 1886 (no. 2345). Apparently the same as F. Müller's no. 146 from Mexico.

Cordia rotundifolia R. & P. Fl. Per. **2**: 24. *pl. 148. f. a.* Unduavi, 8000 ft., Oct., 1885 (no. 1946). The same as Eggers' no. 14001.

Cordia multicapitata Britton sp. nov.

A shrub, strongly ferruginous-pubescent upon the branches, inflorescence, and veins of the lower leaf-surfaces: branches terete, rather slender: petioles 1–2 cm. long, broadly dilated at the insertion: blades 3–12 cm. long, 2–8 cm. broad, ovate, the base blunt to rounded, the apex abruptly short-acuminate and acute, the margin serrate-dentate with short sharp salient teeth, dark-green and shortly pubescent above, ferruginous underneath, the secondaries 7–10 irregular pairs, strongly upcurved, prominent underneath, obscure above, the secondaries and tertiaries successively connecting about midway: peduncles terminal but the lower appearing axillary, solitary, slender, erect, 2–6 cm. long, the heads globoidal, dense, 1–1.5 cm. broad: flowering calyx thick and rigid, about 4 mm. long and broad, somewhat larger in fruit, divided a little below the middle, the tube hemispherical to broader, the lobes triangular-ovate, acuminate to attenuate and acute: corolla nearly twice the length of the calyx, campanulate.

Mapiri, 2,500 ft., May, 1886 (no. 1948).

Related to *C. ambigua*, of Mexico.

Cordia umbrosa Spruce MS. sp. nov.

Branches, peduncles and lower portions of the midribs underneath very sparsely hispid with long, mostly reflexed hairs: petioles (only the uppermost seen) less than 1 cm. long, blackish-brown, stout: blades about 3 dm. long, 12–15 cm. broad, oval, the base blunt, the apex very short-acuminate and acute, glabrous except as stated, membranous but rigid, dark-green, the venation slender but very prominent underneath, inconspicuous above, coarsely reticulate, the secondaries 10 or 12 on each side, mostly alternating, the base abruptly deflexed, then gradually merging into the midrib: peduncle (but one seen) terminal, 4 cm. long, the panicle cymose, loose, 2–5 cm. broad: pedicels short but distinct, stout, articulate: flowering calyx membranous, 3 mm. long, somewhat broader, open-campanulate, the lobes short, broad and obtuse: corolla-tube 4–5 mm. long and broad, campanulate with the mouth slightly contracted, a dark line descending from each sinus, the lobes about 3 mm. long, broad and rounded, abruptly spreading: stamens equaling the corolla, inclusive of its lobes: the anthers 2.5 mm. long, the spreading bases as long as the united portion of the thecae, yellow: styles apparently about equalling the stamens, filiform: stigmas capitate, conspicuous.

Junction of Rivers Beni and Madre de Dios, Aug., 1896 (no. 2608). The same as Spruce's no. 3281, and collected by Pearce at Monterico, 3000–4000 ft.

Cordia Caracasana velutina Britton var. nov.

Softly ferruginous-tomentose throughout, the branches, petioles and peduncles stout, the spikes 2–4 cm. long, 1–2 cm. broad, the leaves finely reticulate, the veins impressed above, finely serrate.

Reis, 1500 ft, June, 1886 (no. 2041) and Guanai, 2000 ft. May, 1886 (no. 2482).

Saccellium Oliverii Britton sp. nov.

Branches slender, somewhat flexuous, sparsely hispid-hairy, like the petioles and midrib: petioles 5 mm. long, stout and broad, blackish: blades 5–15 cm. long, 2–6 cm. broad, ovate, the base rounded, the apex short-acuminate and acute, membranous, obscurely strigose on both sides, the secondaries 9–12 on each side, the venation slender, reticulate, prominent on both sides, especially underneath: panicle small, terminal, short-peduncled: flowers not seen: fruit-pedicels scarcely any: fruiting calyx elliptical, about 3.5 cm. long, 2 cm. wide, tipped with a blackish induration: fruit

blackish, shining, wrinkled, stoutly stipitate and beaked, oblong, slightly 4-lobed at apex, about 7 mm. long exclusive of stipe and beak, 5 mm. broad.

Guanai, 2000 ft., May, 1886 (no. 2535).

Coldenia dichotoma (R. & S.) Lehm. Asperifol. (*Lithospermum dichotomum* R. & P. Fl. Per. **2**: 5. *t. 3. f. c.*) Vic. La Paz, 10,000 ft., Apr., 1885 (no. 1430).

Tournefortia fuliginosa H.B.K. Nov. Gen. et Sp. **3**: 81. Unduavi, 8000 ft., Oct., 1885 (no. 1923).

Tournefortia laevigata Lam. Illust. **1**: 416. Reis, 1500 ft., June, 1886 (no. 1427).

Tournefortia obscura A. DC. Prod. **9**: 517. Mapiri, 5000 ft., Apr., 1886 (no. 1922). Grows in cinchona plantations, as a weed. The same as Spruce's 3886.

Tournefortia Surinamensis A. DC. Prod. **9**: 526. (No. 2049.)

Tournefortia andina Britton sp. nov.

Subglabrous, or the inflorescence, including the outer corolla surface, grayish-pubescent; branchlets stout, spreading: petioles .5–1 cm. long, slender: blades 4–8 cm. long by 1.5–4 cm. broad, oblong to lanceolate, acute at the base, acute or obtusish at apex, dark-green above with the veins impressed, pale yellowish-green underneath, the secondaries about 10 pairs, strongly upcurved, especially toward the margin: terminal panicles sessile, widely branched, the branches 5–8 cm. long, slender, recurved, the flowers sessile, not crowded: calyx 2–4 mm. long, cleft nearly to the base, the lobes lanceolate, tapering, acutish: corolla 7–10 mm. long, cylindraceous, dilated to one half broader about two thirds of the way to the summit, the lobes 1–2 mm. long, erect, on the apex somewhat recurved: fruit 5 mm. long, 6 mm. broad, globoidal with broad, truncate base, blackish brown, glabrous.

Sorata, 8000 ft., Feb., 1886 (no. 1822). Bang's no. 1775 has narrower and less pubescent corollas, while Mandon's 390 has broader and much more tomentose corollas, but I think both are of this species.

Tournefortia graciliflora sp. nov.

Glabrous, or the inflorescence and lower leaf-surfaces very minutely roughened: branches elongated, very slender, weak, angled: petioles 1.5–3 cm. long, rather stout: blades 1–1.5 dm. long, 7–10 cm. broad, oval-ovate, somewhat inaequilateral, rounded or subtruncate at the base, abruptly short-pointed and acute at the

apex, very thin, very dark-green, the weak and irregular venation prominent below, the secondaries 5 or 6 pairs, with short alternating ones: panicle compound, very loose, the rachis flexuous, the branches 5–7 cm. long, very slender, horizontal or somewhat drooping: flowers about 3 mm. apart, on very short stout pedicels: calyx 1.5–2 mm. long, its alternate lobes erect: corolla 6 mm. long, its cylindrical tube 4.5 mm. long, .5 mm. broad, abruptly dilated into a hemispherical or campanulate summit nearly 2 mm. broad, the erect-spreading dark teeth 1 mm. long; mature fruit not seen.

Falls of Madeira, Brazil, Oct., 1886 (no. 1428).

Tournefortia sp.; the specimen in too young a state. Junction of Rivers Beni and Madre de Dios, Aug., 1886 (no. 1440).

Tournefortia sp.; unfit for determination. Guanai, 2000 ft., May, 1886 (no. 2464).

Heliotropium inundatum Swz. Prod. Veg. Ind. Occ. 40. Mapiri, 2500 ft., May, 1886 (no. 1435); Junction of Rivers Beni and Madre de Dios (no. 1438), and Falls of Madeira, Brazil (no. 1436), the same as Mandon's 385 and 386.

Heliotropium Indicum L. Sp. 130. Beni River, July, 1886 (no. 1433).

HELIOTROPIUM BRACHYSTACHYUM (DC.). (*Heliophytum brachystachyum* DC. Prod. **9**: 554). Near La Paz, 10000 ft. alt., 1885 (no. 2539). The same as Spruce's 5778.

Heliotropium parviflorum L. Mant. **2**: 201. Beni River, July, 1886 (no. 1434).

Heliotropium corymbosum R. & P. Fl. Per. **2**: 2. *t. 107.* Yungas, 4000 ft. 1885 (no. 1437).

Eretrichium Walpersii (A. DC.) Wedd. Chlor. And. **2**: 90 (*Antiphytum Walpersii* A. DC. Prod. **10**: 122). Yungas, Bolivia, 4000 ft., 1885 (no. 2581).

CONVOLVULACEAE

Ipomoea fastigiata (Roxb.) Sweet, Hort. Brit. ed. **1** 288; ed. II: 372 (*Convolvulus fastigiatus* Roxb. Hort. Beng. 13; Fl. Ind. **1**: 468). Guanai, 2000 ft., May, 1886 (no. 1987).

Ipomoea floribunda Moric. Pl. Nouv. Am. 46. *t. 31.* Reis, 1500 ft., June, 1886 (no. 1994). The same as Mathew's 1330. No. 1995, from Guanai, 2000 ft., May, 1886, is probably of this species also.

Ipomoea macrocalyx R. & P. Choisy in DC. Prod. **9**: 362. Guanai, 2000 ft., May, 1886 (no. 2056), and Junc. Rivers Beni and Madre de Dios, August, 1886 (no. 205). The same as Mathew's 1332 from Mayobamba.

Ipomoea sidaefolia Choisy, in Mém. Soc. Phys. Genèv. **6**: 459. 1833. (If this is a synonym of *Convolvulus domingensis* Dess. in Lam. Encyc. **3**: 554, of which I cannot satisfy myself, it should carry that specific name under *Ipomoea*). Beni River, July, 1886 (no. 1998).

Ipomoea umbellata L. Syst. Ed. **10**: 924. Guanai, 2000 ft., May, 1886 (no. 1991).

Ipomoea carnea Jacq Enum. Pl. Carib. 13; Select. Am. 26. Unduavi, 8000 ft., October, 1885 (no. 1992).

Ipomoea filipedunculata sp. nov.

Glabrous, very slender: petioles 2 cm. long, very slender; blades 3–6 cm. long, 2–3.5 cm. broad, broadly ovate, shallowly cordate, abruptly acuminate; entire, thin, dark-green: peduncles a little stouter than the petioles, 2.5–3 cm. long, about 6-flowered; pedicels very slender, mostly 5 mm. long; buds lance-ovate, acute: sepals broadly ovate, the outer acutish, 5 mm. long, the inner blunt and a little shorter: corolla 1.5–2 cm. long, apparently purplish, the mouth little expanded: material for dissection wanting.

Guanai, 2000 ft., May, 1886 (no. 1997).

Ipomoea opulifolia sp. nov.

Sericeous throughout, including the corollas in fruit, the leaves glabrous on the upper surface, and twice as large: branches stout or stoutish: petioles rather slender, in flower 3–6 cm., in fruit 7–10 cm. long: blades, in flower, 7–10 cm. long, and about as broad, shallowly cordate with the base slightly intruded upon the sinus, deeply 3-lobed, the lateral lobes acuminate and acute, lightly falcate, entire or with one lobe upon the lower side, the terminal broadly ovate (apex not seen) entire or with a pair of lobes; peduncles stout or stoutish, longer than the petioles, shorter than the leaves, about 5-flowered: pedicels 1–2 cm. long: calyx 1 cm. long, or in fruit 1.5 cm., the outer ovate, acutish, the inner oval, slightly mucronate, 1-nerved: corolla (pale-red ?) 6 cm. long: fruit globoidal, 1.5 cm. in diameter, blackish-brown, nerved.

Guanai, 2000 ft., May, 1886 (no. 1999), in fruit. Description of flowering plant taken from Mr. Bang's no. 2506.

Species near *I. argyreia*.

Batatas edulis Choisy Convolv. Or. 53. Mapiri, 5000 ft., Apr., 1886 (no. 1986). The same as Lechler's 2384.

Quamoclita hederifolia (L.) G. Don, Gen. Syst. **4**: 259: (*Ipomoea hederifolia* L. Syst. 925 [ed. 10]). Reis, 1500 ft., June, 1886 (no. 1985).

Calonyction Bona-nox (L.) Boj. Hort. Maurit. 227 (*Ipomoea Bona-nox* L. Sp. ed. 2, 228). Guanai, 2000 ft., May, 1886 (no. 1993) and Beni River, July, 1886 (no. 1990).

Pharbites heterophylla (Orteg.) Choisy in DC. Prod. **9**: 344 (*Ipomoea heterophylla* Orteg. Hort. Matr., Dec. 9). Vic. La Paz, 10000 ft., Apr., 1885 (no. 1988) and Falls of Madeira, Brazil, Oct., 1886 (no. 1989).

Jacquemontia sphaerostigma (Cav.) (*Convolvulus sphaerostigma* Cav. Ic. **5**: 54. *t. 481.*—*Jacquemontia hirsuta* Choisy in Mém. Soc. Phys. Genèv. viii, 1 (1838) 63). Guanai, 2000 ft., May, 1886 (no. 1844).

Jacquemontia nummularia (Vahl) Choisy Mém. Soc. Phys. Genèv. viii, **1** (no. 1838) 62 (*Convolvulus nummularia* Vahl. Eclog. Am. **2**: 13). Tacna, Mar., 1885 (no. 2007).

Jacquemontia densiflora sp. nov.

Gray-puberulent throughout or the upper leaf-surfaces green: branchlets slender: petioles 1.5–3 cm. long: blades 3–6 cm. long, 2–4 cm. broad, ovate, acuminate and acute, cordate, with broad or narrow sinus, entire, thin, the slender venation prominent underneath: peduncles mostly exceeding their leaves, the cymes 2–5 cm. broad, short-bifurcate, dense, exceedingly variable as to the number of flowers, bracted with linear attenuate bracts: pedicels very short, sepals ovate, 5–6 mm. long, including the long-attenuate tips: corollas (apparently purple) 1 cm. long, broadly campanulate with a short tube, the stamens barely included; fruit globoidal, 3 or 4 mm. in diameter, brown, the pericarp thin and delicate.

Guanai, 2,000 feet, May, 1886 (no. 1845). Bang's no. 2849 is probably a more tomentellate form of the same.

Convolvulus Bonariensis Cav. Ic. **5**: 54. *t. 480. f. 2.* Tacna, Mar., 1885 (no. 1996).

Convolvulus laciniatus Desv. in Lam. Encyc. **3**: 546. Yungas 6000 ft., 1885 (no. 1851).

Evolvulus linifolius L. Sp. ed. 2, 392. Falls of Madeira, Brazil, Oct., 1886 (no. 2009).

Dichondra argentea Willd. Hort. Ber. 297. Vic. La Paz, 10000 ft., April, 1885 (no. 2008), the same as Mandon's 1483, and Yungas, 4000 ft., 1885 (no. 1949).

Alona carnosa Lindl. Bot. Reg. (1844), sub *t. 46*. Near Valparaiso, Chili, June, 1885 (no. 2565).

Cuscuta Chilensis Ker-Gawl. in Bot. Reg. *t. 603*. Near Valparaiso, Chili, June, 1885 (no. 2001).

Cuscuta grossa Engelm. I have not been able to find the publication of this name, which occurs upon the herbarium sheets at Kew. Unduavi, 8000 ft., Oct., 1885 (no. 2003), and vic. La Paz, 10000 ft., April, 1885 (no. 2004).

Cuscuta grandiflora H.B.K. Nov. Gen. et Sp. **3**: 123. Vic. La Paz, 10000 ft., April, 1885 (no. 2006); Sorata, 8000 ft., Feb., 1886 (no. 2005), and Unduavi, 8000 ft., Oct., 1885 (no. 2002).

Cuscuta sp. Near Valparaiso, Chili, June, 1885 (no. 2000).

SOLANACEAE

Solanum amaranthifolium Gill. MS. in Herb Kew (?). I cannot find that the name has been published. The foliage is not exactly the same, but it appears to be the same as Gillies' species, collected at Buenos Ayres. Near Valparaiso, Chili, June, 1885 (no. 2557).

Solanum amblophyllum Hook. Bot. Misc. **2**: 231. 1831. Yungas, 6000 ft., 1885 (no. 806). The same as Mandon's 396 and apparently the same as Jameson's 457.

Solanum amplexicaule Sendt. in Mart. Fl. Bras. **10**: 14. Falls of Madeira, Brazil, Oct., 1886 (no. 2606).

Solanum asarifolium Kunth et Bouché Ind. Sem. Hort. Berol. (1845) 10. Guanai, 2000 ft., May, 1886 (no. 2631).

Solanum asperum Vahl. Eclog. Am. **2**: 17. Mapiri, 5000 ft., April, 1886 (nos. 722 and 788).

Solanum auriculatum Ait. Hort. Kew. ed. I., **1**: 246. Unduavi, 8000 ft., Oct., 1885 (nos. 771 and 780).

Solanum campylocladum Magdalense Dunal in DC. Prod. **13**[1]: 173. Guanai, 2000 ft., May, 1886 (nos. 784 and 798). It is certainly an error to class this as a *Solanum*. It is probably a *Brachistus*, but the specimens lack flowers.

Index to recent Literature relating to American Botany

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Native of Washington.

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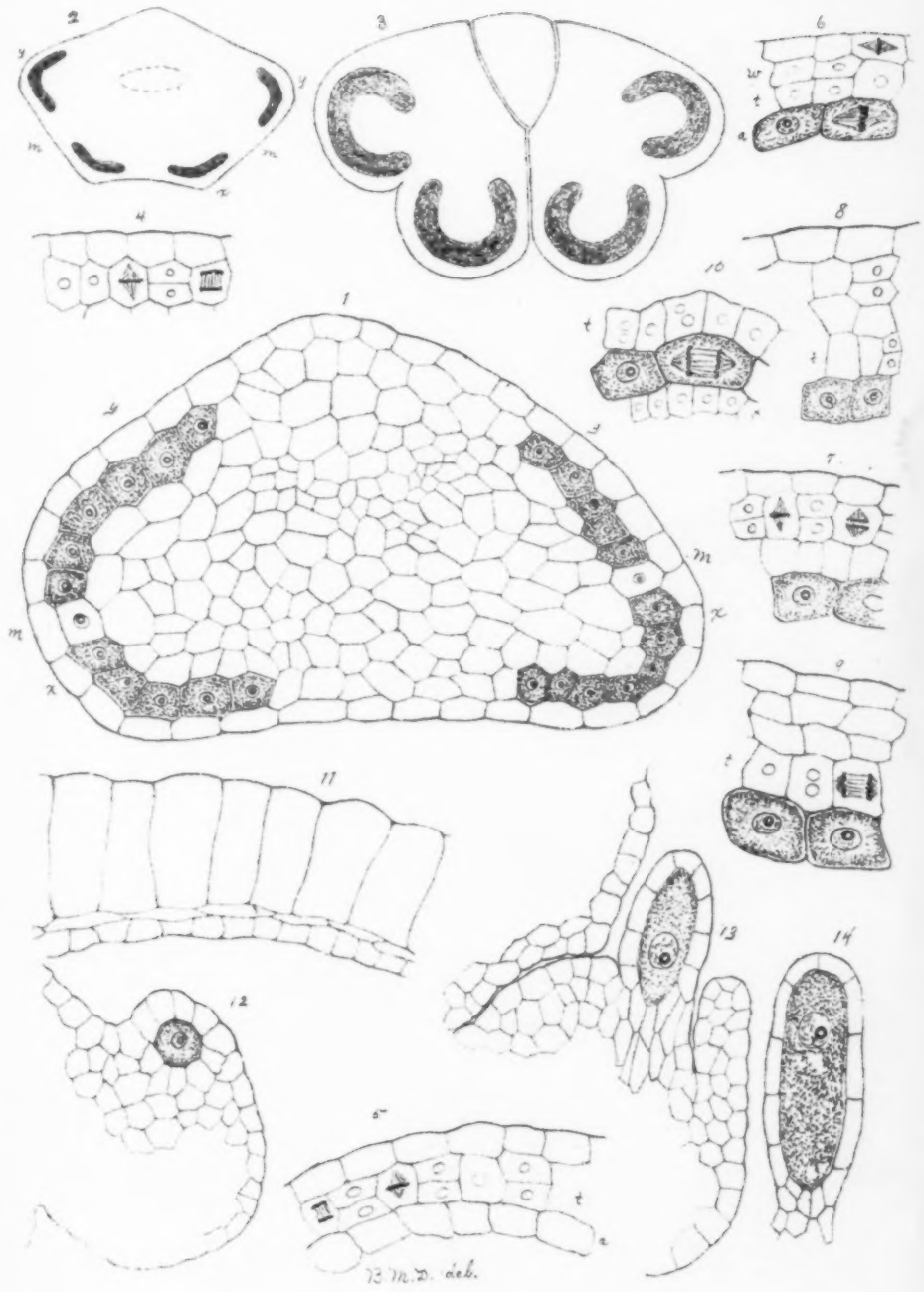

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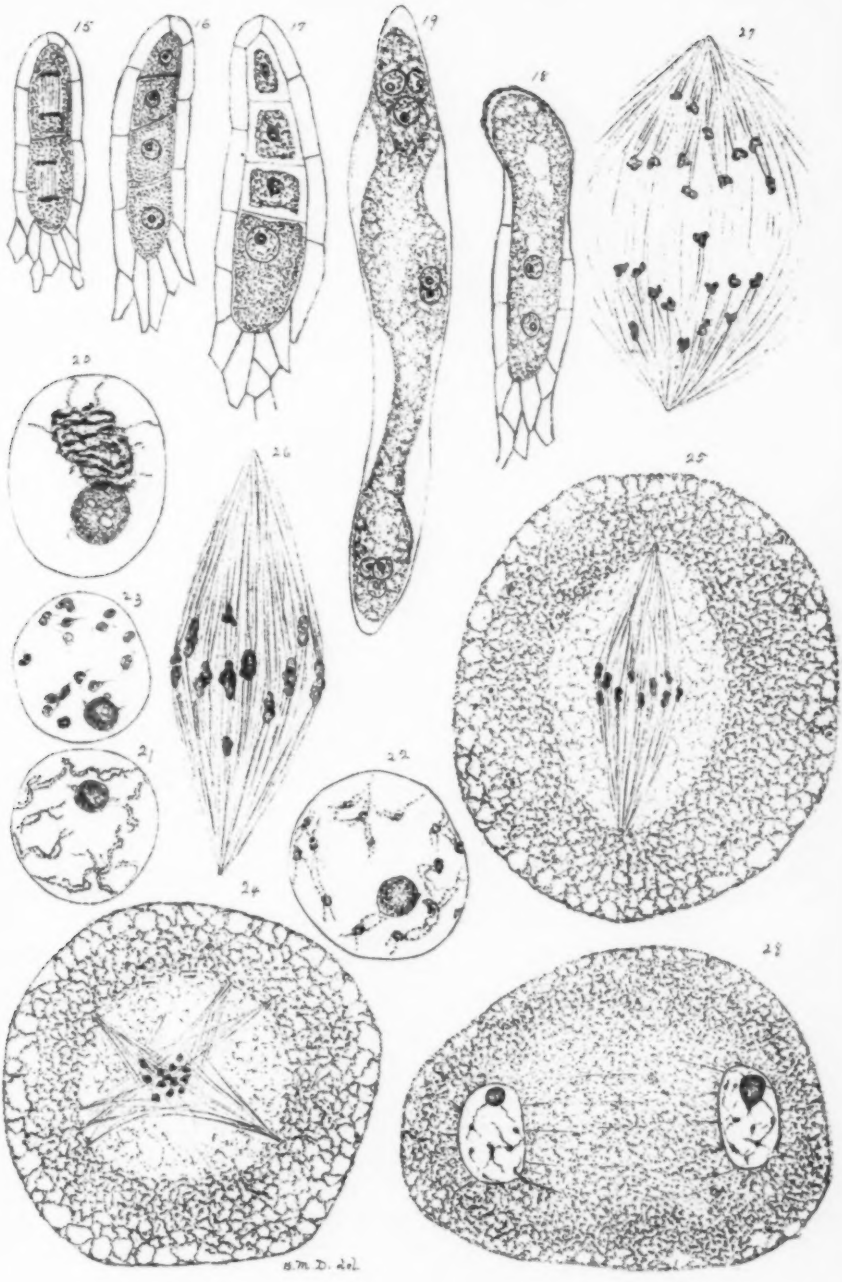

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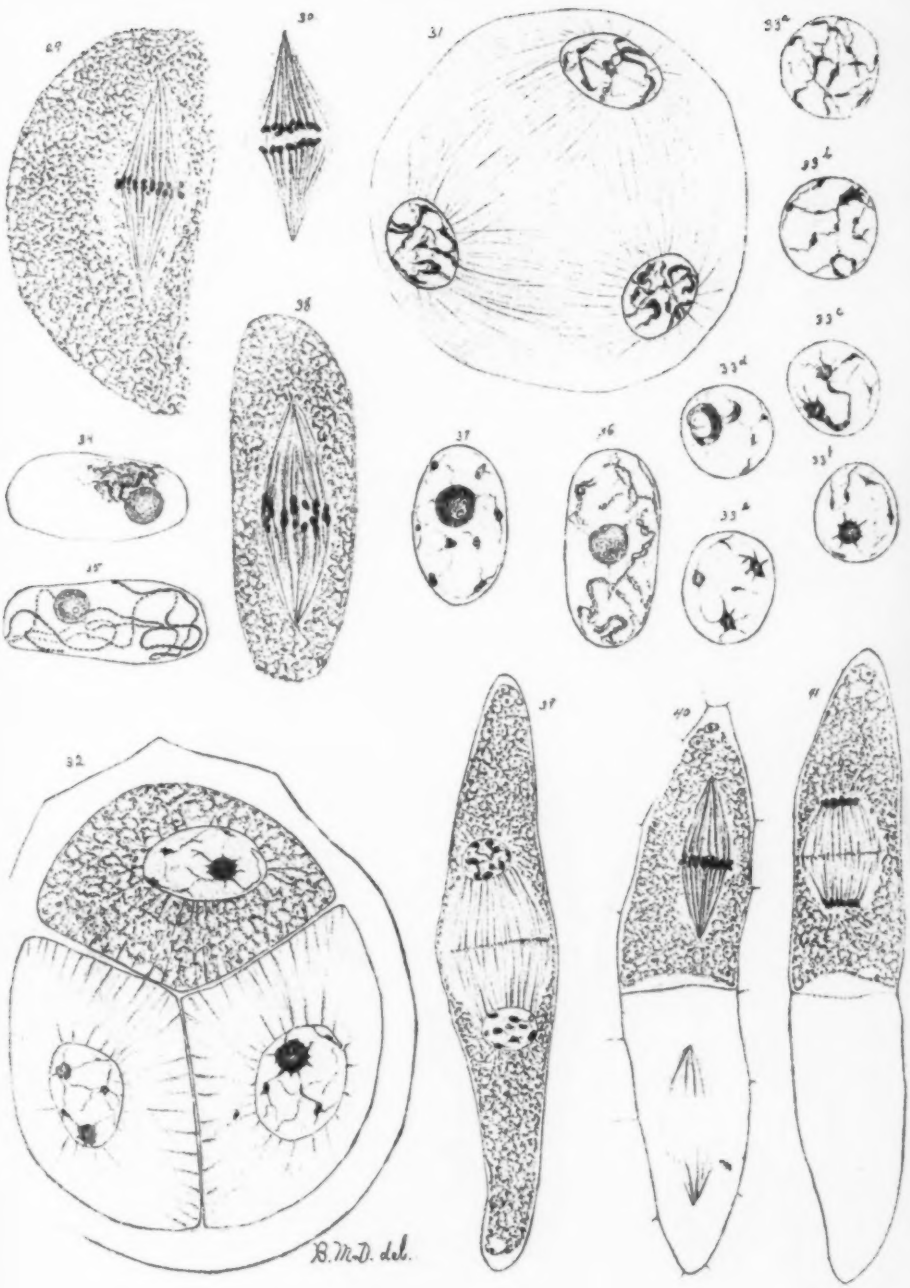

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1. ALLIUM CRENULATUM Wiegand.
2. SENECIO FLETTII Wiegand.

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